PSYCHOLOGY

GLENN D. HIGGINSON

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PSYCHOLOGY

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MESTON TRAINING COLLEGE
MADRAS.

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SET UP AND ELECTROTYPED BY J. S. CUSHING CO.
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In partial acknowledgment of their influence upon my thinking and my writing, this book is dedicated to

MADISON BENTLEY

and

HARVEY CARR

COLLEGE MAR

PREFACE

We have sought to write a consistent psychology. In as far as the logical and scientific execution of this task has clearly demanded strict adherence to a specific point of view, we have been systematic. The thoughtful student or the scientist necessarily seeks and accepts consistency wherever it may be found, irrespective of the particular nature of its trappings. We have, however, at no time emphasized consistency at the expense of fact. We have sought to approach man in this psychological treatment by way of his functions and his products. In so doing, we have happily found ourselves to be in good scientific company. Other biological sciences speak a functional language. The sciences of physiology, botany, zoölogy, and genetics have broken a broad path for us. In each of these fields, a major degree of emphasis is placed upon a functional approach. Each holds that the functional properties of a living thing are known and understood in terms of their respective products. As biological product varies, so does biological function. As a biological organism, man is definitely characterized by the possession of certain physiological functions, such as digestion, respiration, and excretion. They are known and understood in terms of their several products. Moreover, these functional properties of man are inherently determined; their basic causal conditions reside in the nature and constitution of man's protoplasm. But man is also characterized by the possession of certain psychological functions, such as perception, memory, and imagination. They, too, are known and understood solely in terms of their several products. And, in common with his physiological functions, they must be regarded as being basically grounded in the very nature and constitution of man's protoplasm. As his functional products vary, so must man's functional characteristics vary.

We attempt to present a consistent descriptive treatment of man at the level of meaning. Logical thinking and scientific necessity demand this particular mode of exposition. In neither can we find justification for an assumption that man develops functionally

from a meaningless to a meaningful level. Regarded in terms of the data of its own particular field, no sister science confirms such an assumption. We accordingly suggest that a human being functions psychologically from the very beginning and that, as a result, certain psychological products directly emerge. From his very first days, man functions selectively with respect to objects. The infant normally accepts those things which are sweet, and rejects those things which are bitter. There is no scientific evidence which indicates that the sweet or the bitter properties of objects change with increased age; what was there in the beginning is there in the end. The possible sweetness and bitterness, as well as a large number of other psychological characteristics which may be later observed when specific causal conditions permit, are definable and describable properties of objects. They are specific meaningful characteristics which are used alike by scientist and non-scientist in differentiating the many objects of their environments. The psychological properties of objects are observable products of man. They exist solely as a result of the naturalistic relations intimately sustained between a functioning organism (man) and the sources of energy in his environment (outside his nervous system).

We hold, therefore, that man's brain functions under a particular set of causal conditions and that there directly emerges an observable object (situation) which possesses various meaningful characteristics. With brain function, there comes meaning. Regarded in this sense, meaning is a resultant; it is an effect. Object properties emerge, therefore, as a result of this purely causal relationship between a dynamic brain on the one hand and a source of energy on the other hand. Man may be either young or old, normal or abnormal, but he always observes these meaningful characteristics; and, in terms of them, he selects or rejects, handles or manipulates the many things of his world. A functional product actually constitutes one link in an unbroken chain. Man accordingly responds, psychologically speaking, to the observed emergent properties of objects or situations, — not to environmental energy as such. We do not agree, therefore, that man, as a child, must react to physical and chemical energy but that, when he becomes an adult, he acts with respect to meaningful characteristics of situations. We cannot grant this for the child, since we lack any evidence that human beings ever directly observe any form of energy. Man develops in a functional manner by discovering or

adding new properties to old objects (himself or others) and by discovering or adding old properties to new objects. As the observed properties of such objects change, so do their meanings. Psychological growth proceeds throughout at a meaningful level.

Our way of approach clearly provides an adequate principle of scientific integration. We accordingly find it unnecessary to shift repeatedly our basic postulates as we gradually cover the field of psychology. We recognize that in thousands of cases it is at present impossible to describe the particular forms of energy which might possibly serve as stimulus. This is quite evident in ordinary cases of memory, hunger (diabetes), imagination, thirst, day-dreaming, longing (drugs), and ambition. It is strikingly true of the hallucinations, delusions, suspicions, and uncontrollable desires of abnormal individuals. Yet, if we are not to assume some strange or peculiar type of causation in these latter cases, we must hold that the same basic conditions necessarily exist as in case of normal human beings. If we grant, however, that a diseased brain (of an abnormal individual) functions somewhat differently from a normal one (just as a diseased kidney functions differently from a normal one), we can better understand the striking differences to be found in functional products under these conditions. Sane and insane individuals alike, when they observe objects at all, observe them in terms of their several properties and respond to them, if at all, in terms of their observed properties.

Our treatment finds that psychology, in common with other sciences, approaches man in a purely naturalistic manner. It discovers psychology occupying a legitimate and uncontestable place among the several sciences. It allows psychology to deal descriptively and explanatorily with particular basic properties of the objects of the world. Of these properties some are physical, some are physiological, and others are psychological. Those types of properties which can be discovered or revealed by the use of chemical methods are undoubtedly chemical. Chemical methods, whether used in a chemical or in a psychological laboratory, always give only chemical results and data. They necessarily deal with the chemical properties of things. But there are many significant properties of things which cannot be revealed and adequately treated by any known physical or chemical method. Thus neither physics nor chemistry possesses a method of discovering the taste (sweetness) or the color (purple) or the odor (fruity) of a ripe plum.

If there were such an adequate method, these object properties would be physical or chemical. What is true here, applies similarly to a large number of other properties. There is no chemical or physical method of determining those particular characteristics involved in color-blindness, desire, intention, delusion, intelligence, or phobia. The size, shape, distance, color, taste, odor, and familiarity properties of *observed* objects are psychological. They are significant characteristic that emerge under very specific determining conditions which involve a functioning organism on the one hand and sources of energy on the other hand. They are definable, describable forms of functional products; they are, at the same time, observable meaningful characteristics of objects. The methods of psychology, in brief, reveal certain unique properties: the methods of other sciences reveal other unique properties. Psychology has in part its own point of view, its own methods, its own data, and its own explanatory concepts. In all these respects, it is a purely naturalistic science which deals, in common with other sciences, with significant characteristics of things as they stand revealed in specific situations.

We wish to point out that we have deliberately sought to vitalize this treatment of psychology by repeatedly drawing, as we have passed along, from various life situations. At no time, however, has our selection been made with the slightest intention or purpose of "proving" some disputed point. These particular situations have been presented solely in order to exemplify, in a variety of ways, the pervasive nature of psychology. They are intended solely as illustrations — not as anecdotes. We have also sought to avoid presenting a mere compendium of undigested and unrelated facts. We have tried rather to sketch the basic picture of psychology with the full understanding that each individual will retouch it by adding those particular facts and principles which, in the light of his own thinking, he may find necessary in order to make the picture individually satisfying. We have divided our textual treatment in accordance with the two major tasks of science, namely, description and explanation. In each case, the descriptive materials of a topic are first presented. These are purely psychological. The particular explanatory materials are then reviewed. These materials are physical, chemical, physiological, anatomical, historical, genetic, and psychological. The major value of this expository separation must be largely deter-

mined by the extent to which students avoid confusion of psychological data with physiological, physical, chemical data, — that is to say, to what degree they are enabled to distinguish clearly between cause and effect.

Obligations to others for aid, guidance, and encouragement are too great to be discharged; they can only be acknowledged. The author recognizes his debt to the late Kendrick Babcock, Dean of the College of Liberal Arts and Sciences of the University of Illinois, for his sympathetic encouragement and wise counseling. He is also indebted for the nature of their comments upon parts of the manuscript to Professor Paul T Young of the University of Illinois, Professor Leland Stott of the University of Nebraska, Dr. Edward Anderson of Harvard University, Professor Walter Payne of Lyons Junior College, and Mr. David Freidlander. The author wishes particularly to express his deep obligation to his colleague, Professor Elmer Culler, who carefully read and critically evaluated the entire manuscript. Among the several individuals who aided in preparing the manuscript, the author wishes in particular to mention Miss Grace Zerbolio.

G. D. H.

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CHAPTER I

THE NATURE OF PSYCHOLOGY[1]

A. *Kinds of Attitudes*

a. Utilitarian. Man is a creature of manifold interests. Suitable food in sufficient quantities to satisfy basic needs must be secured; adequate shelter through clothing or building must be provided; and proper protection against predatory organisms, either plant or animal, must be established. The problems of satisfying these interests as well as many others of a similar nature are essentially practical in character. They emphasize the usefulness of things from a bread-and-butter point of view. Because of this *utilitarian* attitude, man has combed the earth and sifted the seas in his quest for ways and means of satisfying his practical needs. To secure greater satisfaction, he has established huge industries to manufacture the various tools necessary for a more effective exploitation of both man and nature. He has developed the resources of the land, the water, and the air for the material return which they offer him. He has advanced commerce, furthered trade, and conquered new countries. As a result of the competitive struggle attendant upon his attempts to satisfy his practical needs, man may not be inclined to welcome those social changes which limit him in a personal way. He has, at times, stood strongly against setting aside land and forest areas for purposes of establishing public parks and recreational centers, because he has selfishly sought the timber, the land, and the mineral stores for his own practical purposes. Because the stock

[1] In this chapter we attempt to distinguish among the general ways in which man views his world as a scientist and as a non-scientist. We point out that science has two great tasks, *namely*, description and explanation. And, since we are constantly concerned with these throughout our entire discussion, we try to indicate the various ways in which the sciences, in general, and psychology, in particular, deal with these descriptive and explanatory tasks. In so doing, we attempt to make clear the nature of psychology and its relations to other sciences. The approach here is necessarily broad, and the treatment is rather general, because the topics which we consider are very comprehensive.

men there wanted to use the territory for grazing, the United States government, for instance, actually encountered a great deal of very serious opposition when it sought to establish the Yellowstone National Reserve, out of which Yellowstone Park was later created.

b. Aesthetic. Man, however, is not always practical. This is true even of primitive man. Those peoples who long ago "killed the slave and slew the wife" were most certainly imbued with an attitude different from the strictly utilitarian sort. In many situations, the emotional or appreciative side of human life becomes clearly manifest. This attitude has given rise to a great variety of artistic, literary, and aesthetic products. Through it have been created beautiful paintings, tapestries, and statuary. Because of it, men have fashioned, after a definite pattern, buildings, landscapes, and vehicles in a way to please the eye and touch the heart. One need but turn to the early automobile to find a vehicle built strictly for utilitarian purposes. It most certainly served as a more efficient means of getting man from one place to another than did the horse and the buggy. But not even its best friend would have presumed to call it a thing of beauty. Today, however, the motor car is literally an artistic creation. An astonishing amount of time and energy is now being given to a consideration of its beauty and its style. In this connection the President of Fisher Bodies said, in part, at the opening of the 1934 Automobile Show: "Body evolution has been the result of practical engineering considerations. And when the utilitarian demands were amply satisfied, thought was given to the refinement and beauty now found in motor cars."

Out of this appreciative attitude have also come the values of life. One cannot intelligently speak in a strictly utilitarian sense of the value of a master painting, of a musical symphony, of a beautifully dressed dining table, or of a great actor. The musical or poetic genius seems to possess this appreciative attitude to a much greater degree than do other individuals. Robert Burns, it has been reported, was unable to gaze upon an unusually beautiful sunset without tears springing to his eyes. Such eyes, we believe, must have seen all life — from the creeping louse and the scampering mouse to human beings — in a way denied many of us. These attitudes of practicality and appreciation may occur separately; or, one may possibly dominate a human life almost to the exclusion of the other. They may, however, balance each other fairly well.

Such a balance was apparent, for example, in the well-known American artist, Anderson,[1] of whom Theodore Roosevelt once remarked, "He combines the artistic and the practical more than any other man I know."

Man has his practical moments and his appreciative moments. But in neither the one nor the other may he show an understanding attitude. People have unquestionably lived long, useful lives and died without having apparently possessed much understanding either of themselves or of nature. It has been said that Aristotle, with all his wisdom, died believing that the brain was essentially an organ to secrete water to cool the organism. But man is more than this. He has a head; and he often uses it for very great benefit, both to himself and to society. A story has been told of former President Wilson who once spoke bitterly about a man whom he disliked. "His head!" he exclaimed. "That is not a head. It is just a knot which God put on his shoulders to keep him from raveling out."

c. Intellectual. Many men use their heads, however, for other purpose. The attitude of understanding is to be regarded as being an attitude of the head. It is a particular way of dealing with life that generally seeks to exclude the consideration of purely practical and appreciative matters, as such. It seeks instead to uncover the general character, the particular make-up, and the remote and immediate causes of things and events. It attempts to view life stripped of its usefulness, its morals, its emotional values, its beauty, and its ugliness. It is essentially the attitude characteristic of the physician who examines the old, the poor, and the ugly with the same delicate, searching care that he gives to the young, the rich, and the beautiful. From this attitude, one can regard a beautiful, efficient animal in the same way that a biologist regards a plant. In neither case is one forced to consider the organism as being either friend or food. Furthermore, it is the attitude of any man who is open-minded, receptive, and curious — who is unwilling to reject the new and hold to the old merely because the latter is traditional. It is, moreover, the attitude of the great judge. In this connection, Laski writes that he "is perhaps the rarest of human types, for in being supremely himself he must yet be supremely selfless. He has to strive

[1] Conservationist and first superintendent of Yellowstone National Park (practical); painter of biblical panels: "Neither Do I Condemn Thee" (aesthetic).

towards results he cannot control through material he has not chosen. He has to be in the great world and yet aloof from it, to observe and examine without seeking to influence."

B. *The Scientific Attitude*

Out of man's understanding attitude have come the several sciences. Broadly regarded, they are ways of dealing with life with its related problems which, strictly speaking, consider neither its practical nor its appreciative sides. The scientist, consequently, may often be regarded by the non-scientist as one who is both impractical and cold-blooded. But for the sake of the truth which he continually seeks, the scientist cannot possibly allow values — good and bad, in an aesthetic sense — to intrude and to color his view. It is difficult, for instance, to conceive of a careful physician or of a biologist who would refuse in disgust to study, treat, or deal with some micro-organism because it is associated with some loathsome disease. The scientist, we may say, looks at life through glasses which modify his view in a particular way. He is too far-sighted to see the purely practical or the purely evaluative features of the phenomena of life.

Science has very definite tasks. It must collect its data — usually facts — which are to science as the building bricks are to a house. These facts must then be treated — that is, descriptively arranged or classified — and also integrated or explained, in accordance with some logical principle or set of principles. In this way science secures the order, the coherence, and the significance usually characteristic of its data. The cohesive principle usually takes the form of an explanatory theory, a law, or a generalization. A generalization, which is usually expressed in a few words, may embrace, cover, summarize, and integrate a large number and variety of descriptive facts, into the careful collection and logical arrangement of which many years of hard labor and thinking may have gone. The formulation of such a statement unquestionably illustrates the highest use to which perception, imagination, and thinking may be put in scientific work. As one has put it, "Great men have given their lives to cut pregnant thoughts from raw materials." It is, indeed, a distinctive achievement to produce from a large mass of facts and data, many of which appear to bear no relation to each other, a single common way of viewing all that makes each significant for the whole.

a. Scientific Methods. 1. *Field Work.* The data and materials of psychology are obtained in several ways. In one method, for example, there may be very little, if any, control directly exercised by the observer over the observed individual and its environment. Thus a scientist may possibly perceive, day after day, in a clinic, in a factory, in a class room, or in a store. This type of method is very commonly employed by students of young children and of animals in an undisturbed habitat. In short, it is used wherever strict laboratory control over an individual and its environment is quite impossible without destroying at the same time the unique value of the scientific observations. Under these conditions, a scientist sees, hears, or touches the subject from a given point of view and with a definitely fixed problem (purpose). A considerable amount of valuable data has been gathered in this manner. The careful observer of the behavior of domesticated and undomesticated animals has contributed considerably to our understanding. The student of psychology can learn much of value from the intelligent animal trainer or the woodsman concerning animal behavior. He can also directly learn about human beings by observing the manner in which a child behaves in old situations and how it meets new life situations. He can discover, for instance, how it meets strangers, how it settles its many troubles with its playmates, and how it satisfies its various needs from time to time.

2. *History of Individual.* The field method does not necessarily emphasize a long-time view of the organism. A scientist may, in fact, observe a human being in this manner for only an hour or a day. There are several variations of this rather general method, which are commonly known as the diary method, the case method, and the genealogical method. While these variations have been made to serve different purposes, each has a historical complexion. In some cases, a running account may be made from time to time by one or more observers upon the many changes which characterize the development of a human being. This is the diary method. Again, an attempt may be made to lay bare certain antecedent conditions of a personal experiential sort which have tended to produce activities and attitudes in an individual that are undesirable from a social, educational, and economic point of view. This is the case method. It is essentially biographic in character. It attempts a reconstruction, from various

sources, of certain significant events in the history of an individual. Since these sources are not always reliable, the case method undoubtedly has its weakness. But it is the sole means of securing certain forms of data. While it has been most often used in clinical studies of defective cases, it may also be employed in the study of outstanding individuals — those who are distinctly superior (geniuses). In still other cases, an effort may be made to discover the several hereditary and familial conditions of an individual which have contributed in part to the molding of his life (genealogical method). Two or more of these historical methods may possibly be employed in a study of a single individual. One method may be used to bring the outstanding facts of his history up to a certain period and then another method may be used to gather additional data concerning his activities.

3. *Experimental.* (a) *Preparation and control.* A very great deal of control may be exercised by an experimenter over the various conditions which surround an organism while it is being scientifically observed. This is especially characteristic of the laboratory method. Here the experimental technique finds its fullest and most valuable expression. Such a technique consists, in part, of a thoughtful and logical preparation for making a controlled series of observations upon a bit of material or upon an organism; and, in part, of the actual process of observation (perception). An experimenter attempts to provide adequately for the repetition of observations within a particular situation where both the observer and the thing observed are under as much control as it is possible to establish. An experiment may be either very simple or quite complex, according to the *degree* of control exercised by the experimenter, and depending upon the total number of causative factors that are held under control at any one time. In every experiment, the observer always strives to maintain a fairly definite point of view or a fixed observational set. A change in the observer may possibly result in as much disturbance of the final outcome of an experiment as a change within or around the object which is being observed will produce. In other words, the intra-organic conditions of the experimenter are quite as important as the extra-organic conditions of the experiment. A specific expectation of some result, or a strong desire to prove a particular point, will often interfere very seriously with the value and the significance of experimental data.

(b) *Isolation, variation, and repetition.* Since the object of scientific observation usually occurs under very complex conditions, the experimenter must be able to isolate some particular factor within its gross context or setting, and to repeat his observations many times in connection with it. Figure 1 shows an experimental arrangement for studying auditory perception in a dog.

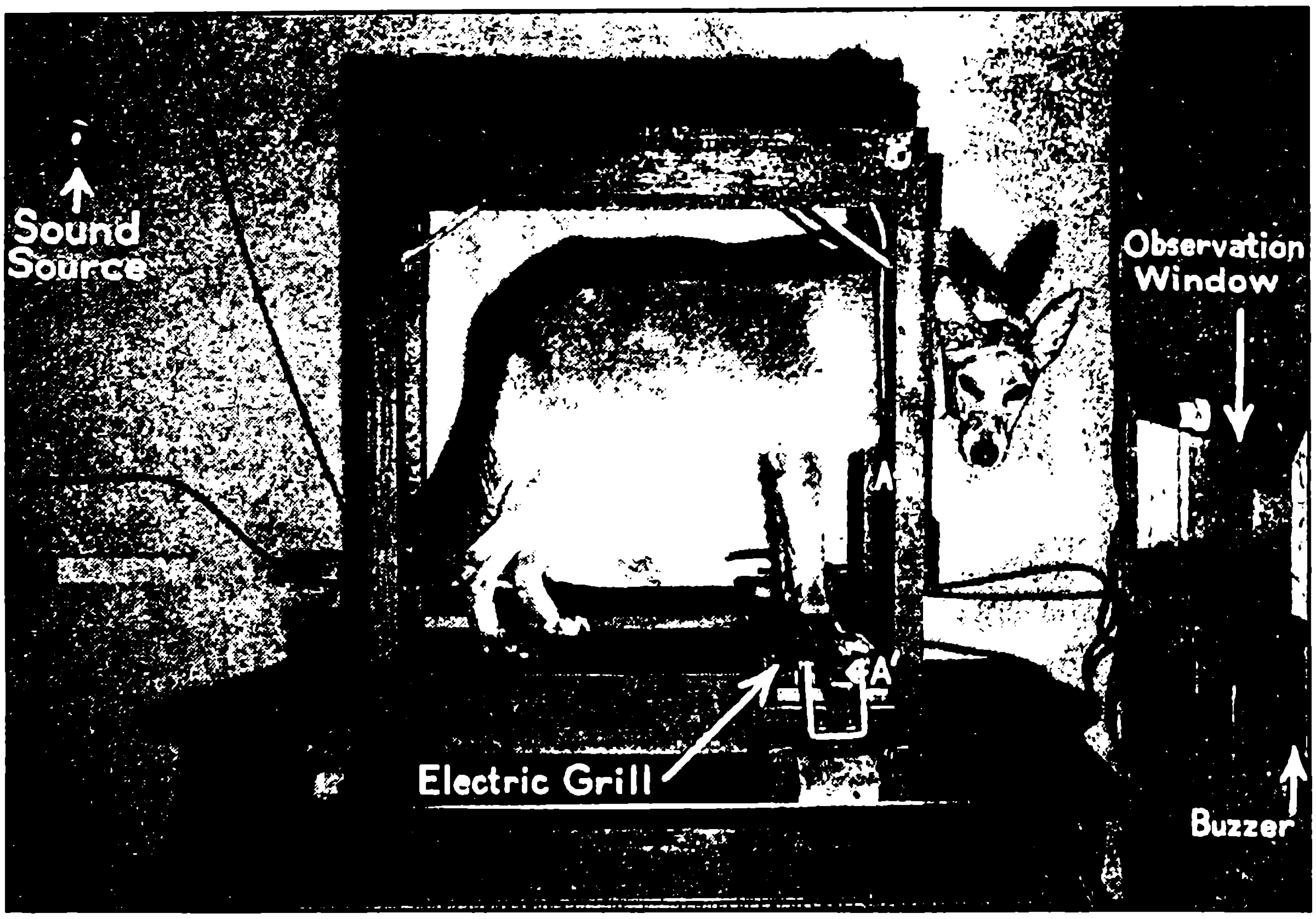

Fig. 1. An experimental arrangement for studying auditory functions in the dog. (From Culler.)

The head of this dog was intensively X-rayed in an attempt to determine the possible effects of such treatment on auditory sensitivity. It is well known that X-ray is beneficial in case of cancer. Perhaps this also holds in the case of deafness. The animal is trained to lift its foot in response to sound. The sound is given and the foot is mildly shocked at A′ Shortly, the animal works differently. It is now possible to determine the degree of auditory keenness, as well as any effect (sharpening or blunting) due to X-raying. The auditory stimulus may be given and the foot-movements noted through the observational window. It is quite possible, by keeping all factors but one — which is commonly known as the independent variable — unchanged and by varying this in a known manner, to secure a fairly reliable description of the several characteristics of an object either human or non-

human. Repeated observations are necessary in order to enable the experimenter to fix definitely the nature of some causal relation between an antecedent change — a change in stimulus or intention — and a resulting change in another factor such as the amount perceived or the solution reached. Repetition of observations, moreover, tends to iron out the slight variations which, because of faulty technique or inadequate control, must necessarily be expected in any experiment; to permit of a careful check upon any doubtful point of relationship; and to discover new properties of an object which might possibly remain unobserved during a short period of study. It is well known that both error and superstition feed greedily upon unrepeated observations.

4. *Tests and Scales.* The employment of various kinds of tests and rating scales constitutes a fourth important form of psychological method. Of these forms, some are commonly used (1) whenever a measure or comparative score of degree of intelligence of an individual or of a group is sought. Through the use of such tests a considerable amount of data has been gathered upon this problem from normal, subnormal, and superior individuals. In terms of their performances upon intelligence tests, individuals can be objectively — quantitatively — grouped as belonging to certain levels of achievement and development. Some may fall, for example, in the upper 10 per cent, others in the middle 25 per cent, and still others may fall in the lower 10 per cent of a tested population. Where these tests have been properly given and the data have been sensibly interpreted, considerable light has been thrown, at times, upon such problems as the nature of the relation between intelligence and social delinquency or between intelligence and failure to achieve.

Other forms (2) are concerned with the discovery of special abilities and aptitudes. Such traits are commonly assumed to be relatively independent of the general intelligence of an individual. Among such, we can cite only two kinds, *namely*, those dealing with mechanical and with musical abilities. Through the former test, a measure of an individual's capability and skill in handling and assembling tools and materials may be obtained. By means of the latter kind of test, an attempt is made to secure a measure of an individual's ability to discriminate between sound-objects in terms of such properties as pitch and intensity.

Still other tests (3) have been constructed to assist in the

psychological study of personality. Among the several forms, we can mention only those which attempt to measure the more general traits of emotional stability, interest, honesty, and suggestibility. In addition to the use of these personality tests, rating scales may also be employed to secure other forms of data which possibly bear upon this problem. A rating scale, generally speaking, consists of a list of traits (perhaps 10 to 100) in terms of which some individual is rated by others who are acquainted with him or who have observed him. This method has been advantageously used in the army to assist in the selection of those men considered to be most worthy of promotion or training. It has also found employment in other fields such as education, industry, and police systems. It has recently been introduced into the police system of Chicago.

b. Types of Description. Broadly speaking, science seeks to produce through its detailed descriptions a semi-photographic view of some object or event under certain specific conditions. When any unitary[1] item is considered, the scientist strives to present within a particular scientific field (physics, chemistry, or psychology) the following sort of comprehensive picture. He attempts to describe a thing (a) in terms of its inherent static properties; (b) in terms of its functional properties, i.e., what it does; (c) in terms of how it changes under a shift in the environment, or with an increase in age — that is, what new activities appear or how old activities decline or disappear; and, finally, (d) in terms of its relations with other things. Let us briefly consider each of these four descriptive ways of regarding objects both human and non-human.

1. *Part vs. Whole.* Upon turning to psychology, we find that simple mental elements may be described in terms of the quality and the quantity of sensations, images, and feelings. The *analytical psychologist*, for example, undertakes to reduce the mind of a human being to its assumed parts, *namely*, sensations, images, and feelings, and to describe these in terms of their inherent properties. Concerning this general position, we are told that careful analytical study by competent psychologists has led to the general acceptance of certain mental data as the principal elements of

[1] If a phenomenon is not regarded as being unitary, then in addition an analytical description will most likely be given. That is to say, the complex will be broken into its parts and each unitary part will be described in terms of its properties.

experience. These factors are valuable in a scientific description of mental life. The three sorts of data into which all mental life, even of the most complex sort, has been resolved by an artificial but scientific introspective analysis are (1) *sensory experience*, (2) *imaginal experience*, (3) *feelings or affective experience*. These three experiences are in no sense independent (33, *59*). (Student: Such parenthetical numbers refer to bibliography at end of chapter, the italic number being the page number in the reference.) The analytical psychologist, for example, would describe, in part, the tonal property of a sound object by referring to its pitch (quality) and its intensity (quantity).

From the same analytical point of view, a *behavioral psychologist* may try to reduce the behavior of a human being or animal to its simplest part, *namely*, reflexes, and to describe and explain these in terms of the functional properties of its various (1) sense-organs, (2) nervous system, and (3) muscles and glands. This kind of analytical attitude is not confined to psychology. We find various students in chemistry seeking to reduce their complex scientific world to its irreducible parts, or elements, and to describe these various parts in terms of their unique properties.

A psychologist may, however, regard a whole — a thing — as being more significant than its possible parts. And he may attempt to describe the inherent properties of such experienced wholes. Life, we know, shows psychological patterns which apparently possess unique properties. The *Gestalt psychologist* has consistently maintained that it is impossible to understand the psychology of an individual, if due regard is not given to the integrative side of his life. He contends that the analytical approach tends largely to destroy the very thing in the human being which is so peculiarly characteristic of continuous living, *namely*, its unity. The point appears to be well taken. Perhaps a very common chemical analogy will serve to make this position more understandable. It is recognized, for instance, that water — the substance used to remove dirt, quench thirst, and extinguish fire — most certainly possesses unique properties, that is, properties which are not to be discovered in the parts. Moreover, other properties such as liquidity, specific gravity, density, and boiling point cannot be reduced to the properties of hydrogen and oxygen.

2. *Function.* But a description of such properties either of the part or of the whole is not enough for an adequate or a complete

understanding of a thing. It must be admitted, for instance, that an individual's life also shows various dynamic or functional characteristics. We may read in physiology of the various functional properties of the human brain, or of the human stomach. In the same way, we can truly speak with the *functional psychologist* of those properties of a total human personality, or of a living organism, which issue, in part, from the particular nature of its relations with its environment. We recognize, therefore, that perception, imagination, and thinking must properly be regarded as being functions or activities of a total human organism. They are not regarded in any sense whatsoever as being parts of the mind or as being activities of the mind. We shall not regard man as possessing a mind, which is clearly separable from the various and unlike activities shown under life conditions. Pyschological activities must be differentiated from non-psychological functions in terms of what is produced, or what is done by the organism. The important functions involved in heredity, if we may use an analogy, are known by what is produced. There is no other way of studying such functions, or for that matter any other kind of function. We raise this matter at this time to make clear that we regard the human organism, within limits, in quite the same manner as other biological sciences do. There is no sufficient scientific reason for regarding it in any other manner. We shall again consider this matter when we come to Chapter IV

(a) *Definition of function.* No difficulty should arise nor misunderstanding occur concerning the meaning or the use of the term "function" as it is employed here. We do not wish to give a peculiar or strange scientific usage to the term, merely because we happen to be dealing with psychology. In general, the use which is intended here is quite like that to be found in other sciences, such as biology or chemistry, where the functional approach apparently possesses considerable value for scientific understanding. The student of psychology will find much more in common with these sister sciences, if the nature of function which we present is properly understood and sensibly applied. Function, simply stated, includes ways in which an animal form, or a chemical substance — such as water, acid, rubber, sugar, and oil — or a human being (personality) produces a *change* in a part of its environment — the total situation — or is *changed* because

of a change in its environmental relations. It specifically refers, in psychology, to the way in which a total individual works, performs, achieves, or reacts. We assume, without question, that scientifically speaking there is always an *organism* — human or animal — and *its environment.* The various ways in which a living organism acts toward a given environment are regarded here as being *functional properties of the organism.* That is to say, each human being shows certain psychological activities. Each of these *activities* we shall regard as a *functional property.* In order to make our position perfectly clear, let us consider a few common illustrations drawn from chemistry and psychology.

(b) *Functional properties of chemical substances.* Some functional properties of water are recognized by every individual. Water, for example, may change a human being by removing dirt from it, by reducing its heat, and by quenching its thirst. Certain functional characteristics of some acids are agreed upon by persons who never had a course in chemistry. Acids burn human flesh, preserve certain fruits over long periods, and etch steel and marble. Finally, some functional properties of rubber are generally known. It sheds water remarkably well, lessens the vibration and the noise in a motor car, and restrains electricity from escaping into space or into a human being. In each of these cases *something is done;* some change — effect — is produced in the thing's (substance's) environment. And, in each case, some change is also presumably made or occurs in the functioning thing or substance.

Such functional facts as these must be properly recognized; we cannot possibly escape from them. Moreover, they must be accorded a proper place in our descriptive scheme of scientific relations. Physiology, chemistry, physics, for example, stress this type of functional property. But what shall we say about the psychological properties of man? Here, where legitimately we might expect the same functional view to be generally maintained, we may find something quite different; some other type of approach may be unduly emphasized. And with this emphasis, there usually goes a loss of regard for those fundamental functional properties which possess inestimable significance for psychology. Let us glance now at some functional properties in the field of psychology. These properties are, in part, very different from those functional properties of a chemical substance.

(c) *Functional properties of man.* Man is a dynamic pattern of energies. He views or regards his world, both animate and inanimate, as it lies around him. Like water, or acid, or rubber he possesses certain *functional properties* as a result of which great changes are inevitably produced in the objects surrounding him. We do not mean necessarily that, like an acid, he tears, burns, or etches the objects of his environment. We merely mean that any given human or non-human situation necessarily becomes changed whenever an individual *enters* as an actual functioning part of it. Human beings "do things" to their environments. Of some of the ways in which these changes in a situation may be produced, man is completely unaware. These we shall largely disregard. Of many other functional changes, however, he has direct knowledge. These we shall consider in considerable detail.

(d) *Functional products.* Man looks about him and sees environmental objects which possess among others, such *properties* as color, size, shape, distance, and motion. These are psychological. They are results of man's functioning. They are, in short, functional products of man. The *psychological* properties unquestionably qualify in various ways the many objects which compose his known world. He differentiates among his surrounding *objects* in terms of their several properties in quite the same way that a chemist in his laboratory may distinguish one object from another in terms of its *color, taste, weight,* or *melting point.* Again, man may thoughtfully consider an environmental situation for a time and, then, as a direct result it may possess much significance for himself and others. Until he had thoughtfully approached it, the situation was not understandable; it was less meaningful. But when he had finished with it, however, it had become more meaningful. Mysteries are usually made clear by injecting some particular bit of meaning into them. Through thinking, for example, man introduces meanings — new properties — into life situations. Man repeatedly faces unsolved situations and comes forth with some adequate solution (change). In so doing, he often uncovers other aspects (properties) entirely new to him which may in turn invite his further efforts at understanding.

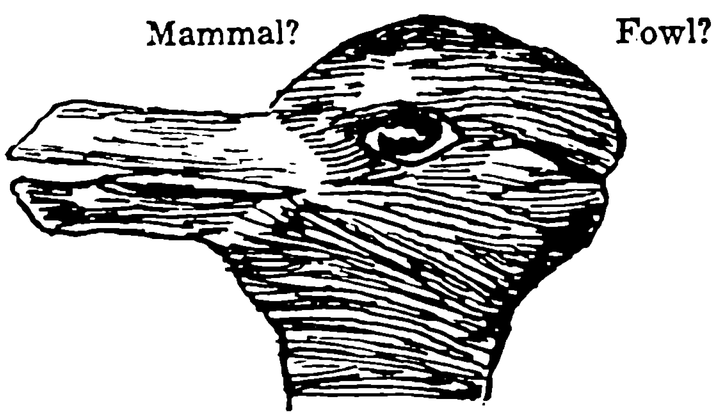

FIG. 2. Are you able to observe two objects at the same time?

This, we must point out, is really life; this is what man actually does. He perceives, remembers, imagines, acts, and thinks; and in each and every case, he does something to a total situation of which he, himself, is an *inseparable* part or feature. To remove man from a situation is to destroy whatever psychology there is in it.[1] For his own understanding, we ask the student to compare what man does, functionally speaking, with what is done by water, an acid, or a bit of rubber. Broadly speaking, they are somewhat alike, as he can readily see; yet again they are vastly different. These differences, when properly understood, are certain to make clearer the very significant differences between the sciences of chemistry and psychology. They will no doubt serve at the same time to provide the student with a larger understanding of the nature of psychology and its materials. The student will accordingly understand that the chemical properties of *one* substance, for instance, may possibly be known and properly described solely in terms of what is actually done to (what change is produced in) some *other* chemical substance. Oxygen, for example, cannot be *seen, felt,* or *smelled.* That is to say, it has no single property that can actually be perceived. But it will, however, cause a glowing match, by increasing its rate of oxidation, to burst into flame. This is a strictly chemical — but non-psychological — property of oxygen. Oxygen would not be oxygen if some form of it did not show this particular property — that is, if it did not change or affect a glowing match in this manner.

But psychological properties are quite different. The psychological properties of an environmental object or substance can be known only in terms of the *nature of the relations directly sustained between such an object or substance (a source of energy) and a human being.* As a matter of fact, the chemist and the psychologist may at times regard exactly the *same* properties of some *one* object. Smell, taste, and color are commonly recognized properties of chemical substances which are repeatedly referred to by the chemist in his descriptions and read by the student in his textbooks. *Yet they are at the same time psychological.* That is to say, they exist solely as a result of one type of direct relationship, *namely,* that which is to be found between (1) a functioning organism and (2) some form of situational energy. The psychological properties of an object must necessarily be regarded, therefore, as being

[1] We disregard here the matter of the subhuman organism.

functional products of a human (or an animal) organism which functions in a situation.[1] Color, size, shape, distance, taste, noise, and movement, to be specific, are observed properties of objects. Such objects may be human or animal, living or non-living, physical or chemical. Psychologically (scientifically) speaking, there can be no object without a property and no property without an object. If it is properly regarded, Fig. 3 will make our point clear. The student should hold the book flat and on a level of his chin with the figure about 4 or 5 inches away. He will then see a third line (between each pair of crossed lines) of different length and direction. It also shows movement when either the book or the observer's head is moved. This particular perceived object is accordingly different from the other perceived objects in this same figure.

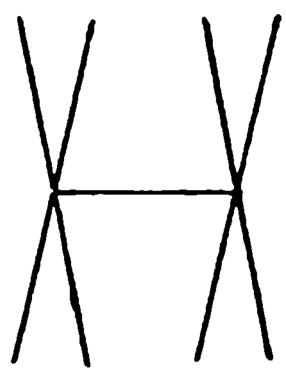

FIG. 3. Is the new (emergent) object more psychological than the paired objects?

As a further aid to his understanding here, let the student consider the nature of some brilliant dyes. Until the last century, such dyes were either plant or animal products. Today, they are usually produced chemically from ordinary coal tar. From this one source, more than a thousand different dyes have been produced. During the pre-war era, when it was striving to dominate the world market, the German Government is reported to have spent more than five million dollars in developing a single dye. Men labor and spend, then, to produce chemical compounds which are extremely valuable simply because they possess certain *color* properties. Now these color properties must not be regarded in any sense as being properties of the individual chemical elements which compose the structure of coal tar. The colors cannot, therefore, be isolated by any form of chemical analysis. They must be regarded as being properties of *particular* chemical integrations when such are regarded in terms of their relations to particular living organisms. We say "particular substances" because many substances have not been discovered to possess such properties. And we say "particular living organisms" because many forms do

[1] We may ask: What is the speed of a steam engine? The answer depends upon wind, road, coal, water, temperature, grade, and driver. There is no speed aside from a situation. We may ask: What is the color of an object? The answer depends upon light, the nature of the eyes, fatigue, and the closeness of observation. There is a reason for displaying goods under a daylight lamp. Under other lamps, the colors are different.

not function in such a way as to produce such colors. The gorgeous dye, then, is absolutely as much a matter of *psychology* as it is of *chemistry*. It is as much a matter of organic (brain) function as it is of chemical structure. Mauve, the first dye developed from coal tar, was discovered by Perkins while trying to clean a test tube which had some coal tar in it. While washing it with alcohol, he observed that the coal tar had suddenly taken on wholly new visual properties. Instead of being a dingy black, it was now a striking purple.

The student should recognize that this matter of properties is not purely academic or theoretical. On the contrary, it may have great legal and economic significance. In this connection, a recent ruling of an Illinois Court which will annually involve in payment of taxes alone a sum of many millions of dollars may be illustrative and instructive. Upon the disputed question of taxability, the Court ruled against the contention of a score of public utility companies that electricity is intangible and therefore cannot legally be taxed. Now, here is the interesting and significant side. The majority of the properties of electricity upon which this court decision and these public utility companies' claims were based are actually psychological. Court witnesses included Langmuir, a well-known electrical engineer who is assistant director of research for General Electric; Compton, who is a Nobel man in Physics; and Carlson, who is an eminent physiologist at the University of Chicago. Compton, for example, pointed out that electricity can be *tasted*, while Carlson testified that it can be *felt*. According to reports, one non-psychological property was mentioned by Langmuir, *namely*, that electricity has weight in the power line. Since it was held that these three properties can belong only to tangible substances, the Court ruled against the utility companies.

Finally, it should be recognized that although an object or a substance such as an acid, for instance, may show several unlike functional properties, it always possesses unity; it is, above all, a total pattern. Man, too, shows various unlike functional characteristics; yet his life always reveals a high degree of integration. And the particular unity in either case becomes even more significant when properly considered in terms of the extreme diversity of the several unlike activities.

The functional properties of a unit — a chemical substance or a human being — can only be known by what it does *within a given*

situation. It would seem that chemistry, as an actual working program, is largely concerned with an understanding of the functional properties of its materials. Chemists have discovered, for example, that a substance may not explode with an increase in heat — so it is known that dynamite may be burned like a stick of wood. But the chemist has also found that under other specific conditions dynamite may easily be exploded. As an actual working program, psychology is concerned with an understanding of the functional properties of its materials. The psychologist learns that a feeble-minded individual may possibly attack another under very slight provocation. But he also finds that another individual with a different heredity and a dissimilar training recognizes fully the rights of other human beings and does not molest them. It is the business of psychology to deal intelligently with those fundamental characteristics of the human being which fall within the boundaries of its field.

3. *Developmental Changes.* In addition to a statement concerning the static and functional properties, a complete psychological description must necessarily include some reference to the way in which human beings develop either slowly through the processes of racial evolution, or more rapidly through the many unlike changes which characterize the development of an individual from his birth to his death. All things, including man, necessarily change. Some things and some men definitely appear to change in the direction of a pre-determined end or goal. Here, generally speaking, we discover progress. Other things and other men, however, may not change in this manner. An adequate psychological description must refer, therefore, to the various changes, either progressive or otherwise, which inevitably appear during the course of an individual life as a result of such conditions as increase in age, disease, fatigue, exercise, growth, decline, and continued functioning.

4. *Causation.* Finally, in any complete psychological account there must be some description of scientific interrelationships; that is, how one property of a thing (a human being) is causally related to other properties either of the same thing or of other things in the world. This is really the very common, but extremely difficult, task of explanation. Generally speaking, in every explanation an attempt is made to show how a property, a change, or a modification in one phase of a life or the world is either directly

or indirectly related to a property, a change, or a modification in another phase. We trust that the student will realize that these four kinds or forms of description which we have referred to here are not mutually exclusive. They necessarily overlap to a greater or lesser degree. Let us now look at this last form of description (explanation) in somewhat greater detail.

c. Forms of Explanation.[1] 1. *Analytical.* Explanations in psychology take several forms, depending upon the particular point of view assumed by the student and upon the specific type of problem with which he is concerned. A careful consideration of the several forms of psychological approach to life problems reveals the following possible ways of explaining. In psychology, as in other sciences, analysis or reduction of a patterned phenomenon to various parts is assumed to constitute one form of explanation. It is held by the analytical psychologist that life, or activity, or behavior even in its simplest moments, must always present a rather complex side to an observer. By reducing such an integrated whole to more elementary parts, an individual is often assumed actually to have explained the complex. Much of the work of the analytical psychologist is accordingly concerned with the task of reducing human experience to its elements, or to reducing the behavior of men to its physiological and anatomical units. This type of explanation may be compared, for purposes of better understanding, with that of the analytical chemist who may attempt partly to explain water in terms of the inherent properties of the analyzed parts, *namely,* hydrogen and oxygen.

2. *Synthetic.* In a second form of psychological explanation we find the antithesis of analysis. Here explanations are commonly put in terms of properties of the whole which is definitely assumed to possess inherent and unique properties. These particular properties are not reducible either to a more simple and elementary — different — status, or to the various categories of other sciences. Explanation, from this angle, need not necessarily be referred

[1] The student should realize that science is unable to give a complete explanation of anything. It cannot push a chain of causal agents back until it comes to the beginning of anything, because back of everything must lie some cause. Causation must be endless. Science cannot tell why muscles contract easily and nervous materials do not. It cannot tell why gold is heavy, or why some light waves are long and others are short. It cannot tell us why man is able to remember, or imagine, or think. In short, scientific explanation has its limitations. The student who seeks a final explanation of anything will not find it in science.

beyond the whole itself. It is recognized, for instance, that the hue of a particular substance is chemically explicable solely in terms of the particular *combination* of particular elements. For example, when carbon, hydrogen, and oxygen are properly integrated, the resulting substance may be purple. When any change is made in the carbon, or hydrogen, or oxygen side of the molecular pattern, the hue disappears. It seemingly depends upon the whole — *not any one part*. Life patterns are therefore assumed to have their own unique properties which, like the properties of chemical substances, presumably defy any further analysis or reduction. "They just are." *Gestalt* psychology tends especially to emphasize this particular position. The individual may recognize, for instance, the face of his friend; it is, he says, familiar. That this particular property does not really depend upon any one facial feature may be actually determined by the student. Let him seriously attempt to discover which particular part, if any, of an observed face is necessary in order for such recognition to appear. It is one property of the *whole* face. A similar position is likewise to be found in functional biology, where explanations to be acceptable need not be stated in terms either of simple analyzed parts or of physics and chemistry. Some students have consistently maintained, for instance, that life as studied in biology cannot be scientifically regarded as being the *sum* of various chemical elements each of which is, in itself, wholly "lifeless." On the contrary, *life is itself regarded as being a process*. It is, moreover, wholly irreducible. Furthermore, it has its own properties which are regarded in essentially the same manner as the inherent properties of lifeless substances are.

3. *In Categories of Physics and Chemistry.* In another form of explanation, the psychologist may attempt to reduce the antecedent or causal factors of a psychological phenomenon to the several categories of other sciences. Some individuals apparently believe that, if the various data of psychology can be directly related to the sciences of physics and chemistry, a complete or adequate explanation has thereby been derived. Such students commonly hold that no explanation in any field can properly be regarded as being scientifically valid unless it is wholly reducible to the descriptive terminology of the physical and chemical sciences. In this connection, we must point out that if a purely mechanistic type of explanation is desired, an individual unquestionably finds it in

terms of these two sciences. By such an explanation, we simply mean that particular type of description for which the *terminology* (concepts) of chemistry and physics is scientifically sufficient. These sciences unquestionably provide an adequate, although not final, explanation of the functioning of a *mechanism*, such as the gas engine. When the physicist and chemist have completed their chemical and physical descriptions of the operations of a gas engine, there is nothing left to be considered by any *other* scientist, such as a psychologist, a zoölogist, or a physiologist. For all such relations as are to be found in a lifeless mechanism, these former sciences are quite sufficient. We do not question, moreover, their adequacy for such descriptive problems. But we are forced, however, to point out that any thoughtful attempt to reduce the functional properties of a human being, — a living, striving, ambitious, imaginative creature, — to the descriptive level of physics and chemistry, i.e., to those several categories descriptively adequate for a gas engine, must immediately lead to the realization of the gross insufficiency of such concepts. A different sort of account is most certainly demanded for the activities of the human being.

The student should properly recognize that each particular branch of scientific endeavor has its own particular categories of descriptions. We know that it is scientifically desirable to reduce descriptions of all things to the simplest terms consistent with the facts. But considerable confusion immediately arises under our present methods and our degree of knowledge when men attempt to force rigidly the terms of one science upon the materials of another. While physical concepts undoubtedly work admirably in the field of physics, we must insist that they are unquestionably inadequate, under present conditions, in the fields of psychology and biology. No scientist — chemical, physical, or psychological — is descriptively able to reduce the various psychological functions or activities, including among others those of perception, memory, and thinking to anything approaching a purely physical or chemical level. We may indeed do well to recognize always that a high degree of interrelationship necessarily exists between psychological events and physical processes. There may be a possible dependence of one upon the other, but this in no way means that the two are wholly identical. Psychological phenomena belong essentially to one order; physical phenomena to another. Clear thinking and scientific progress demand a distinction.

4. *In Terms of Personal and Racial History.* A final form of psychological explanation emphasizes the very important rôle played by the history [1] of an individual, a group, or a race in determining its several psychological activities. We recognize, on every hand, the very great significance which the doctrine of evolution holds for an understanding of psychological materials. In this manner are variously explained the form and the nature of the many structures and functions of the human being. Through evolution is derived a more adequate comprehension of the various developmental changes which occur in a race or in a species. A particular type of protoplasm, we say, has lived and functioned under a particular environment. And both the protoplasm and the environment are clearly recognized as being determining factors in the evolutionary process and in the possible product. "The total organism," one writer remarks, "is not made in a day. Its developmental history is engraved within it." Within a survey of the field of psychology, therefore, we should find a place both for the evolutionary history of the organism and for those progressive or genetic changes under which the human individual is formed between birth and adulthood (1, 27).

The importance of history as a form of explanation becomes strikingly apparent when the behavior of an individual organism is examined. It should be quite evident to the understanding student that a human being functions or acts in a certain way at a given moment partly because of his *own personal past*. Out of the struggle, the conflict, and the striving attendant upon living come definitely formulated ends or goals to be attained. These goals, produced largely through the use of the functions of imagination and thinking, tend strongly to color and to determine the subsequent course of a life. An individual, we know, may fight just as quickly and just as fiercely to achieve some desired objective which has been created through his psychological functions as he does to satisfy his biological needs of hunger and thirst. Moreover, a primary psychological result of a goal is to bind and integrate an individual's activities into coherent, significant patterns. In this way, both meaning and effective guidance may be

[1] The significance of history has been well expressed by Morley. "I want to know what men did in the thirteenth century," he says, "not out of antiquarian curiosity but because the thirteenth century is at the root of what men think and do in the nineteenth century. It is the Present we seek to *understand* and to *explain*."

given to an individual's efforts to achieve. To show the presence of some goal or a psychological objective is to explain in part many of man's activities. Wigmore aptly remarks: "Life, as a purpose and a career, is an effort to reach an unattainable ideal"; the ideal is the aim toward which we commonly strive.

It is agreed that a single experience may serve to illuminate and to change the whole course of a person's life. The following story, we believe, will illustrate this point quite well. It was told by a woman who owns a copy of the picture, "Neither Do I Condemn Thee," which hung in her drawing room at the time this incident occurred. One day a visitor waited there for her while she was detained. Upon coming into the drawing room, she noticed that her visitor was strangely ill at ease. The latter left rather abruptly after a short conversation. Some time later an explanation of her behavior was given. "When I came to see you," her visitor said, "I sat for some time looking at that picture, and I was so impressed that it changed the object of my visit. I had come to say good-by, as I was intending to leave my husband and go away with another man. But as I sat studying that picture, I changed my mind. I went back to my husband, and I am living happily with him." Students of abnormal psychology duly recognize the necessity of securing an understanding of an individual's personal history. Furthermore, it is scarcely possible to scratch the surface of many other psychological problems without using the historical method. As we shall later show, *functional* and *dynamic* (Freudian) psychologists tend to stress the great value of this form of explanation.

C. *Some Psychological Problems*

We wish to warn the student who is desirous of securing a workable understanding of psychology that he must not overlook either its nature or its sources of material. The psychological aspects of life, which are evident upon every hand to the observant student, are often more striking than the non-psychological forms. Whenever an individual perceives, remembers, imagines, or is emotional about some object or some event; whenever he moves with respect to an object to deal satisfactorily with it; and, whenever he pauses to think out the solution to a problem dealing with an object or an event — there are the materials of psychology.

a. Pre-school. Some children are very timid, while others are fearless; some are rather quiet, while others are boisterous; some

are quite docile, while others are intractable; and some are very bright, while others are dull. These psychological characteristics, among many others, appear in pre-school children. The psychologist is becoming increasingly interested in the various incidents, struggles, and conflicts which occur during the infantile and post-infantile periods of an individual's life as well as the several ways in which these are finally resolved or settled. It is becoming increasingly evident that such factors may contribute directly to the production of many serious troubles and conflicts during adolescence and adulthood. These early years of life seemingly influence materially an individual's subsequent psychological attitudes toward himself and his social situations. In many ways, childhood and youth linger in an individual's life.

b. School. Human beings go or are sent to school to be functionally prepared for effective participation in those life affairs which they must face beyond the school room. One major psychological problem which thereby arises is generally concerned with ascertaining the actual capacity or the ability of these immature individuals to be trained by the school; a second general problem has to do both with the determination and with the intelligent application of the most efficient methods of producing the desired preparation in the individual.[1] Here occur the many major problems which concern the most effective methods both of teaching and of learning. Finally, there is the general problem which is concerned with the reliable determination through the use of examinations and tests of the actual extent or degree to which the individuals have been prepared by the educational institution. This is, in part, a problem of the actual efficiency of a particular form of training.

c. Industrial. Leaving school and entering industry mark a rather decided change in the nature of the psychological problems involved in the lives of individuals. The major psychological problems of industry appear to center largely around two main tasks. The first has to do with the working out and the employment or application of reliable methods of getting the right kind of person into the right kind of job — of properly fitting a man and a job together. The successful solution of this general problem

[1] It should be understood that it is not the business of psychology to set the final ends or goals to be attained in the class room nor to determine the materials to be taught.

apparently depends to a considerable degree upon the nature of the knowledge obtainable about the job and about the individual. In order to proceed effectively here, the psychologist must have an understanding of the individual in terms of his intelligence, his perceptual abilities, his action patterns, his emotional stability, his training, and his several major attitudes. The second large task concerns the problem of increasing the efficiency, the happiness, and the morale of the individual worker. The solution here demands that proper consideration be given (1) to the character of his tools, the work benches, and the illumination; (2) to the job itself to see that it is neither so difficult nor so easy that the worker is either discouraged in the first case or bored in the second; and, (3) to the individual himself in order to see that he is given an adequate opportunity to work at his optimal pace with full assurance of personal safety and the possibility of industrial advancement.

d. Advertising. Along with the problems of production of industrial goods goes the task of selling them. Here, too, several psychological problems arise. Some of these have to do with the most effective use to be made of such properties as color, size, shape, and arrangement of advertisements; others are concerned with the value of suggestion and emotional appeals, or of argumentation and reasoning appeals in creating confidence in some advertised article. Each problem deals with some phase of the general attempt to bring individuals to perceive and to read about an advertised article; to make them interested in the article by appealing to such deeply seated desires as those for health, wealth, or sex attraction; and to cause them to think about the article when they finally come to buy.

e. Legal. If individuals come in conflict with various social institutions they may learn at first hand something about the psychological side of the law. Some general problems here concern the relation between such psychological abnormalities as feeble-mindedness, epilepsy, and insanity on the one hand, and delinquency and crime on the other. Other problems have to do with the character and the amount of some observed situation which may be perceived and accurately reproduced at a later date in a court room. Another problem concerns the possibility of discovering the existence of criminal knowledge through the use of psychological methods. Additional problems center, for instance,

around the important matter of the responsibility of delinquents and criminals when they are properly viewed in terms of their heredity, their environment, and their personal history.

f. **Human Contact.** Psychological problems of sociality are concerned, generally speaking, with the way in which perception, memory, imagination, emotion, action, and thinking develop or change under contact with other human beings to produce socialized characteristics of objects such as sharing, belonging, or possessing. One may, for instance, share with another individual through perception or in memory some common object, such as the moon or a little child. Or, one may share with another individual through thinking some problematic situation, such as the causes of depressions or the natural sequences of life forms.

In each of these several illustrations, one or more functional aspects of a human personality may be involved. Each human being shows some phase of psychology during every waking moment of his life. The discerning student will himself observe those various psychological phases of human behavior. He will realize, moreover, that no individual can legitimately expect to secure a full understanding of life from a textbook. For the latter can serve merely to open doors, or to reveal partial vistas. The understanding student will surely lift his eyes from the pages of the text and attempt to look at life itself; he will necessarily make his own applications.

D. *Relation of Psychology to Other Sciences*

Science represents, as we have seen, a certain type of knowledge secured and organized through the observation and the thinking of trained individuals each of whom works either temporarily or permanently under a definite set or point of view. Each scientist uses a particular method and the method necessarily determines in part the nature of the product obtained or the knowledge acquired. The use of an X-ray machine may accordingly reveal by photograph, bodily changes which are completely unobservable (directly perceptible). With the exception of the psychologist, each scientist tends somewhat to ignore his own functioning. He attempts instead to study either directly or indirectly (by physical and chemical methods and instruments) the objects of his world. Such objects, he assumes, possess properties which are wholly

independent of his functioning organism. The psychologist, however, is more interested in the actual way in which a human being functions in perception, or in memory, or in thinking, to produce those various characteristics of objects and situations which cannot be revealed solely by the use of some physical instrument or chemical test. There is, for instance, no known physical or chemical method of determining scientifically the familiarity or unfamiliarity of an object. His major task is to understand the psychological functions of man and animal — to describe them and to explain them. To resolve this task psychology necessarily draws upon various sources.

a. **Physics and Physiology.** Physics contributes through the information which it has to offer upon the *properties* of the various physical stimuli which constantly affect the organism and which serve *partly* to determine the character of its several activities. The psychological problems of seeing and hearing, for instance, are generally related in this sense to the purely physical problems of the number and the intensity of light and sound waves. Psychology and physiology are also quite intimately related. Physiology deals with certain *functions* of the body or "parts" of the body, *namely*, stomach, heart, glands, nervous system, etc. In each of these physiological functions, as studied by the physiologist, no such product as a meaningful property or characteristic of any environmental object or situation ever emerges. The adrenal glands, for instance, function and a particular unique product (adrenin) thereby appears. This functioning and this product may be carefully studied. But the adrenals, we say, do not function in such a way as to cause some environmental object to possess properties of place, color, movement, or familiarity. Its functions are clearly related, within limits, to many other physiological functions of the organism. But the adrenals, physiologically regarded, do not perceive or think about objects which surround them. This also holds true for every other *physiological* function. Physiology, then, studies certain functional properties of the human organism. Physiology naturally studies certain functions of the brain (nervous system). It may study, for example, the rate at which the nervous impulse moves along the nerves from one region of the nervous system to another region. It may use delicate instruments in such studies. But the movement of such impulses over the nervous system is not *identical* with

the functioning whereby an individual sees gorgeous colors in a flaming sky. Such latter functioning, we say, is different. *It is different as measured in terms of the products.* It is psychological.

But the organism cannot possibly be divided, except for purely scientific purposes, into such parts. It is actually a unit. It is accordingly recognized that changes in various physiological functions, e.g., respiration, circulation, digestion, and excretion may be accompanied or immediately followed by changes in psychological functions. Physiological information, then, must unquestionably contribute at times to psychological understanding. But physiology and psychology are not identical. In certain respects, the methods are different and the products are also different. The physiologist in studying the functioning of the eye of an individual may ask: What color do you see in this environmental object? If he does, he is actually using psychological products as a means of studying visual functions.

b. Neurology and Chemistry. Psychology is definitely tied up with neurology. Neurology studies certain functional properties of the nervous system. Psychologists who talk in terms of the mind commonly agree that what it does is always determined in part by the nervous system. They say that the mind must be partly explained in terms of peculiarities of the nervous system. They usually point in this connection to the effects of drugs, diseases, and injuries upon the mind. We assume, however, that neurology and psychology simply study the same *nervous system* from different angles. The major task of the neurologist does not concern the meaningful characteristics of the individual and of his environmental objects. Since we attempt here to discuss not *mind* but functional properties of the nervous system, the student will readily understand why certain *physiological* and *neurological* facts fit properly and adequately into our account of the causal or contributory factors of the psychological functions. Those particular brain functions of the organism as a result of which particular properties or characteristics (meanings) emerge in a situation are very definitely unique; they are also psychological. It should be clear, then, that whatever knowledge and understanding may be secured concerning the character of the integrated functioning of the nervous system of an individual must certainly contribute, within limits, to a better understanding of both normal and abnormal forms of the psychological functions.

The chemist may likewise add further to an understanding of psychology through any information which he may possess concerning the functions and the products of the various glandular systems of the human body. Biologically speaking, man is a very highly integrated organism. Two great integrating agencies are the blood stream, which constantly bathes every part of the body with various chemicals of various degrees of potency, and the nervous system, roughly comparable perhaps to a telegraph system, which binds all parts of the body together into a closely-knit unit. Other things being equal, the more we learn about the non-psychological functions of these two great integrative agents, the more we are likely to understand about the psychological life of an individual. This is to say, the individual is actually an inseparable unit possessing many unlike functional properties. These properties may be classified as psychological, physiological, neurological, chemical, and physical. We necessarily *assume* that these are intimately related. We cannot, however, demonstrate this relationship in a great many cases.

E. *Our Method of Approach*

It is our primary intention here to provide a psychological approach to the human organism. We intend especially to treat with *man* as a human being. Animal psychology is very important; but, properly regarded, man is in no sense an enlarged edition of any subhuman organism. Though his roots undoubtedly reach back, genetically speaking, to subhuman levels, man himself is in many respects unique. A complete description of its roots cannot possibly give a picture of the fruit of a plant. An understanding of animal behavior, both valuable and significant, often possesses only a very remote historical interest in the study of human beings. Man, properly regarded as an emergent stock, must necessarily possess new properties or characteristics. We shall accordingly draw freely upon sources of information concerning subhuman psychology whenever it is evident that by so doing some point can be more *adequately* and interestingly made, or a larger insight concerning general psychological principles be secured. Our major emphasis, however, is upon man. The demands of time and space must be considered; they definitely limit the scope of our treatment.

We shall consider how man as an individual functions psychologically in his environment by way of perception, memory, imagination, action, emotion, and thinking.[1] We shall attempt to indicate how these various activities are determined and changed by such factors as instruction and learning, exercise and fatigue, growth and decline, and heredity and disease. We shall try to point out from time to time how individuals differ both normally and abnormally. We shall also refer in passing to the nature of those socialized changes which occur in an individual under contact with other human beings. Finally, we shall touch upon some of the more general problems of personality. We turn now to consider in Chapter II some of the more general factors which are concerned in the determination of psychological activities or functions. We shall discuss these under the major heads of biological, physiological, and psychological forms of preparation. In Chapters II and III, we attempt to show the motivational basis of behavior. We shall discuss instincts, habituated needs, and psychological conflicts.

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[1] It must be fully recognized that we in no way limit man's environment to the immediate physical and chemical conditions surrounding him. A great many phases of such an "environment" may have absolutely no effect upon him. Man actually begins at birth to create his own environment. As he gradually develops, this environment becomes diversified and expanded. Through memory, imagination, and thinking, an individual may at last produce a world quite peculiar to himself in which he may become almost wholly isolated. In this connection we recall a statement of Learned Hand that man reaches "out towards all of nature on which to impose the forms which his busy brain contrives; and so he literally creates his world, fabricating now this, now that."

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CHAPTER II

BIOLOGICAL DETERMINATION OF ACTIVITIES

I. Introduction

The significance of the historical approach to an understanding of the human organism becomes clearer after an individual has properly evaluated some of the problems of motivation. The search for motives is truly the quest of the historian, the psychologist, the psychoanalyst, the lawyer, and the biographer. The fascinating problems of motivation continually challenge the curiosity and tax the understanding of many serious students of human behavior. Hidden within the general problems of why men perceive, act, think, and feel as they do, lie some of the most fundamental questions of life. The motives of man are the springs of human conduct. From them, to use a common analogy, flow some waters that are sweet, and other waters that are bitter. Various students have repeatedly sought, for the sake of man's health as well as the general advancement of his scientific understanding and thinking, to discover the exact nature of these deep-seated sources from which issue a significant amount of regulation over his psychological functions or activities.

The motives of an individual's performances are essentially a product of his history, when considered both racially and personally. That is to say, some arise in part because he possesses, as a member of the human race, a total biological structure that is similar in many respects to that of many other species of living creatures. Other motives appear, however, because man, as a species, is actually different from all other creatures. These significant differences are both structural and functional. As a result of man's long racial history, certain functional predispositions or determining tendencies have been laid down in his organism (nervous system). He is biologically or racially tuned, as we shall try to show, to perceive various inherently determined

characteristics of his organism, such as hunger and sex, and to act in various ways toward himself and his would with respect to these properties in order to secure satisfaction. Finally, during the course of his psychological development from the infantile years to the adult level, he faces literally thousands of situations. Many of these unquestionably leave permanently their impress upon him. He is, therefore, in part what his personal history has made him. He is a living organism molded or shaped by such conditions as his heredity, his personal history, and his environment. He cannot possibly escape from his history. From one point of view, we can rightfully say that an individual has not *had* a certain history, but that he *is* a certain history. In quite the same sense, we can say that a man does not have this kind of habit or that particular trait, but that he *is* (among many other things) this habit or that trait.

The Law Considers Human Motives. By way of illustration, let us note that the law is becoming increasingly interested in the determination of the several motives operating in the lives of individuals who have become delinquents or criminals.[1] Many judges are gradually coming to recognize that a fuller understanding of the various motives which lie back of socially and legally undesirable behavior patterns may actually lead through intelligent treatment to a permanent reformation of such individuals. This is especially true in the case of the more youthful offenders. The delinquent boy or girl is more and more being considered as one who is deserving of corrective treatment intelligently applied with a sympathetic hand, instead of emotional or ignorant condemnation. Recent years have witnessed a decided change in the major attitude and the general procedure of those persons who deal with juvenile delinquents. The latter are being brought in increasing numbers before judges in juvenile courts who are often possessed of special qualifications for dealing with such youth, and who are assisted by trained workers. In the semi-privacy of these courts an intelligent attempt is now being made to discover the various antecedent and contributory factors of the delinquent patterns of such individuals. Each boy or girl under these conditions is regarded as a human being and not, for instance, as just another case of stealing or truancy.

[1] For a very interesting account of various motives in criminal behavior, the student is referred to *Forty Years of Scotland Yard*, by F. Wensley.

This work, that usually goes on so quietly that the average individual knows nothing about it, is tremendously valuable. In many cases it undoubtedly means the actual salvaging of boys and girls who would otherwise be brought before a different type of judge, who would either free them to return to the same old conditions of life which originally contributed to their delinquency, or send them to some penal or reformatory institution where they would most likely be permanently marred. Often the primary motive back of the behavior that lands an individual in a juvenile court may be the strong desire to belong to a gang, or to be the leader of a gang. And, where a heavy premium is actually placed, as it so often is, by the street gang upon delinquency, a boy may possibly be led, against the dictates of his earlier training, to commit serious offenses against society. In so many of these cases, it seems that youth, lacking adequate opportunities for the release of its energies along socially approved lines, tends to find less desirable outlets. When properly motivated, many juvenile delinquents become normal individuals.

II. Biological Determination

A. *Instincts in Animal and in Man* [1]

Among the several biological conditions which serve to motivate animal and man, are the *instincts*. Like many terms, however, instinct carries its burden of unlike meanings. For some, an instinct is a specific hereditary form of behavior whereby some natural end is attained. Through the operation of an instinct, an organism is led *independently* of environmental guidance and training to the performance of some activity which serves some particular end. The pattern of instinctive behavior is assumed to be predetermined in the germ plasm of a species. The specific way is set in the stock. The instinct expresses itself — runs its natural course — when the *right* environment or situation arises. If the right environment is not provided it at its proper time, the instinct may disappear. When it does appear, however, it may be greatly modified by changing the environment. The behavioral patterns are thus regarded as being hereditarily fixed. They are specific ways of dealing with specific objects.

[1] For an interesting work, the student is referred to *Animal Psychology*, by Munn.

a. Specificity. McDougall, for instance, has emphasized this position. Instincts represent for him certain hereditary forms of activities which have survived — that is, have been transmitted from one generation to another — because of their value to a given species or race. They are considered as being major sources of energy in the individual organism which serve strongly to motivate it in unlike ways under unlike conditions. Upon instincts, as a basis, the human race or individual builds those intellectual patterns which are so necessary for its significant achievements. An instinct, considered from this angle, is a definitely determined hereditary condition of an individual by virtue of which the individual is forced (1) to perceive some specific object in a situation, (2) to act in a *specific* manner toward it, and (3) to feel or experience a definite type of emotion at the same time it perceives and acts. The essence of an instinct reduces, accordingly, to a specific relationship existing between a particular, experienced object, and the particular actions and emotions which are manifested by the organism toward the object. An instinct, it would thus appear, is essentially an innate push toward environmental objects. As a result of an instinct, an organism is presumably driven toward the realization of some biological end or purpose, such as mating and the care of young.

One may, however, regard an instinct in a somewhat different manner. One may consider it as being *in part* a hereditary characteristic of an organism whereby satisfaction may be secured. The possibilities of certain types of satisfaction must be regarded as being inherently determined characteristics of the various members of a group. They are stamped by the race upon the individual. Such inherently determined needs are both very *persistent* and *insistent*. But the particular mode of satisfaction in every case is determined *in part* by life situations. That is to say, the need itself is necessarily defined finally in terms of the way or form of gratification. The possibility of sexual satisfaction, for example, is inherent in the organism. Moreover, the *form* which the gratification assumes in each particular case is an essential part of the whole instinct. We can know some need only in terms of the forms of its *expression*, which are at the same time ways of satisfaction. One form of sex behavior is to be regarded, therefore, as being no more or no less instinctive

than another form. Self-gratification is thus considered to be as instinctive as any other form.

An instinct is a pattern which shows unlike sides. There is, accordingly, that aspect which is in part inherently determined and which we may compare, for purposes of understanding, with the dynamic thrust of a plant which shows itself in growth. But there is that other aspect which is determined in part by the organism's environment and its personal history and which we may again compare roughly with the final form that the growth takes, *namely*, its direction. It is wholly impossible to state precisely where the one ends and the other begins. The thrust in some respects is undoubtedly basic to the whole plant's development. In this sense and degree, inherent need is a *basic* characteristic of the instinct. The student will do well to recognize that such a need can be adequately understood and measured only in terms of the nature of its satisfaction. The satisfaction is in part dependent upon the environmental conditions involved in an organism's development.

This way of thinking does not, therefore, regard an instinct in its entirety as being something which is *wholly inherent*. But at the same time it does not regard it, strictly speaking, as being either an acquisition or a modification of something which is innate — no more than we would say, for instance, that a plant which during its development bends toward an open area of sunlight in a forest has *acquired* a bent position or has been *modified* in some manner. Instinctive activity stands, at any time, as the actual resultant of various determining factors to be found both inside and outside the organism. It must be clearly understood that under one set of conditions, one type of instinct — one type of organism — develops. But under another set of conditions, another type of organism develops. Each is entirely natural. And each is fully understandable only when properly considered in terms of such unlike factors as heredity, environment, and personal history.

An experiment on animal locomotion will make our point clearer. The eggs of a frog were hatched under two unlike environmental conditions — the one involving ordinary fresh water, the other in water containing an anaesthetic. Under the first condition swimming gradually appeared. The anaesthetized group, however, remained quite motionless. When the non-drugged tad-

poles had reached a rather vigorous swimming stage, the drugged animals were then removed to fresh water. Here the effects of the anaesthetic were shortly removed. Thirty minutes of this new condition found the formerly drugged animals as active as the original fresh-water group.[1]

Regarded as being fundamental characteristics, which are usually thought of as being transmitted directly through the germ plasm of the stock and developed through the normal processes of organic growth in the same way that many other dissimilar characteristics of the organism are, instinctive needs apparently furnish a valuable way of *explaining* certain forms of animal and human behavior. They cannot be rejected without impairing our understanding of behavior. In this general sense, they may be considered as determining, within limits, the activities of an individual at certain times and in certain situations. An instinctive *need* may therefore be regarded as being an important characteristic of a particular form of protoplasm. Where the protoplasm is essentially alike, as in a given species, and where the environmental and historical conditions are quite similar, a great deal of uniformity in many behavior patterns of the members of a group will be discovered. Some types and characteristics of behavior must be explained in terms of instinctive determination. The individual does not acquire these needs. He does not control their appearance or disappearance, their rise or decline. We again point to such needs as hunger. From a biological point of view, the individual most certainly has nothing to do with the appearance, reappearance, persistence, and insistence of such needs. They are inherently determined characteristics. They color, within limits, a human being's whole life. A realization of the part they play contributes to a larger understanding of human affairs.

b. Classification of Instincts. No one single way of classifying all instincts which relates each to every other has ever been advanced. It is perhaps better for the sake of clear thinking to regard these fundamental characteristics of life in somewhat the same manner as the chemist does the properties of non-living substances, such as ordinary water. There is, for example, no necessary relation between any two properties of water, such as liquidity and thirst quenching. Each thing or substance has

[1] Carmichael, L., "Development of Behavior in Vertebrates Experimentally Removed from the Influence of External Stimulation." *Psychol. Rev., 33.*

many unlike properties. There need not be any necessary relation between any two of them. We cannot classify the instincts of an organism solely in terms of a particular kind of stimulus-object or environmental situation. Nor can we sharply differentiate them in terms of any particular kind of behavior which may be found at any given time. Sex, for example, which we regard as being instinctive, cannot be adequately described solely in terms of any one particular object, situation, or kind of behavior. The satisfying objects may vary. It may be the individual itself, or one of the same sex, or one of the opposite sex. Moreover, the activities in each case may vary widely. When properly regarded, sex, like other instincts, shows a number of unlike activities, any one of which may exist independently of all others for a longer or shorter period. Hunger, too, may be satisfied in different ways and by different objects. One particular way, we must remember, may possibly not be wholly sufficient at all times. It may not always be the satisfying way.

Some common implications which we shall critically consider here are as follows: (1) that where heredity is regarded solely as determining any particular instinct, a knowledge of the environment and the personal history of an individual is unnecessary for an understanding of it; (2) that at a purely instinctive level there can be choice[1] or selective behavior involving two alternatives; (3) that there is a particular end or purpose for which a particular instinct is naturally intended; (4) that the concept of *modification* of instinct through environmental changes leads to the notions of perversion and reversion; (5) that while an instinct has a definite predetermined time of appearance it may possibly be delayed in making its appearance until several years have elapsed following birth; and (6) that if an instinct is not exercised at its natural, that is, predetermined time, it either disappears or tends to disappear. We wish to touch rather briefly upon these implications and to present some factual material upon each point. The student should clearly understand, throughout this whole discussion, that we *definitely accept instinctive determination*, with certain necessary limitations to

[1] Choice, we recognize, is always the choice of a result — of some form of satisfaction. According to one student, it is the result of a "conflict of desires with duties, of instincts against ideals. At other times, choice is nothing more than the weighing of alternative methods of attaining an end" (21, *367*).

its usage, as furnishing one form of explanation of human activities. We shall attempt accordingly to indicate some of these limitations and to establish our position.

One student, for example, has pointed out in connection with this problem of classification that since all instincts owe their existence to their usefulness, the uses subserved by the various instincts should be the basis of classification, and since to a considerable extent all animals have the same general needs, a classification based on the *ends* gained by instinctive acts will apply to all forms of animal life, including man (11, *66*).[1] We do not recognize, however, the existence of any legitimate, useful end that does not really consider the organism in terms of its own satisfaction. The maintenance of life, self-preservation, and the perpetuation of the stock, for instance, may very well be regarded as being ends. But they clearly lie outside or beyond the organism. We are unable to accept such ends as being instinctive. They are merely significant resultants of the organism's own satisfying activities. In every case, we must point out, the sole *end* of instinctive behavior, at least as far as human beings know it, lies in the satisfaction of some hereditarily determined need. And this satisfaction necessarily contributes at the moment to the happiness and contentment of the individual.

c. Some Implications. Several important implications appear if one regards the doctrine of instinct in a certain manner. This is especially true when instinct is considered from the teleological point of view — that is, according to the first way which we have described. The student must possess some understanding of these implications, we believe, in order to be able properly to evaluate this very common way of explaining many activities of living organisms. The student can neither intelligently accept nor reject a particular doctrine of determination of the activities of living organisms without giving due consideration at the same time to the actual limitations necessarily imposed in either case upon the way in which he regards such activities. It is not sufficient, we maintain, merely to accept or to reject. It is also necessary to understand. And to understand in this case is to realize some possible consequences — and to recognize the ade-

[1] The student is also referred in this connection to Gates, A., *Psychology for Students of Education,* for a different classification in terms of impulses, reactions, and stimuli. Under various headings, Gates lists a large number of instincts.

quacy as well as the inadequacy of a way of approach. We wish to try to *understand* instincts — not to *reject* them.

d. Instinct as a Hereditary Tendency. An instinct is often regarded as being a purely hereditary condition or factor of an organism. The instinctive behavior of a particular individual is held to be definitely predetermined as a result of various events occurring during the long development of the species or the race. The personal history of the organism, considered from this point of view, is assumed to play an unimportant rôle as a determining factor in its various activities. The instinctive pattern, presumably established in the nervous system of an individual as a racial characteristic, merely awaits its *proper opportunity* in order that it may definitely and clearly express itself in the form of some particular determined action. If such an opportunity is not given the instinct, although regarded as actually being present, does not appear. Dogs, for instance, are assumed, as a result of instinct, to bury bones and other kinds of food. Since so many dogs actually do not bury them, the food-burying instinct is generally held to exist dormant in every case, although it may fail to express itself in any manner. In such cases, of course, the functional criterion or real test — what an animal does — is clearly abandoned. The continued existence of an instinct, irrespective of an animal's behavior, is nevertheless assumed.

e. Fear as a Learned Reaction. We assume that there is a hereditary aspect of each instinct which partly accounts for its universality and its persistence among the members of a particular species. In this connection, however, we also assume that the factors of environment and training also possess significance. The rôle of each of these factors may be better understood perhaps by considering certain activities which are rather widely accepted as being instinctive. Let us consider first the matter of fear, which is usually regarded, even by such extreme environmentalists as Watson, as being an innately determined pattern. The student will bear in mind during the following discussion that we simply attempt to reduce the *inherent* side of fearful *behavior* to the universal tendency of living organisms to make escape movements under *pain and discomfort.* The emphasis is upon *pain* and *discomfort.* There is, we assume, no *instinct of fear* which may be described in terms of a specific inherited pattern of responding to a *particular* stimulus-object or situation. Fearful behavior

appears as escape or withdrawal movements under pain, injury, or discomfort. Just any way — whether it be swimming, running, crawling, dragging, hopping, tumbling, rolling — even though it has *never before been used*, may be instantly employed in escaping.[1] We have repeatedly seen wounded animals, apparently seeking to escape, behave in ways which they could not possibly have used on any *earlier* occasion. Among human beings, fearful behavior may appear in any situation, either perceived or imagined, that is painful or injurious. And a large number of escape patterns may be observed at different times.

1. *Fear in Undomesticated and in Domesticated Animals.* We wish to avoid any possible misunderstanding. We present here an explanation of a wide variety of actions to be found in animals and in human beings. Like any other explanation, it is essentially an interpretation which is based upon certain factual materials. As a source of some of our data we wish to refer the student directly to certain types of *undomesticated* animals to be found, among other places, in the Antarctic regions, on Galapagos Islands below the Equator, in the United States, and in Canada. Such creatures are apparently quite unafraid of man. Some forms of these animals, such as the penguins of the Antarctic, had never come in contact with man until Scott explored that region. Other kinds of animals, however, are fairly close neighbors of man. In addition to all undomesticated forms, we wish to refer indirectly to the countless number of domesticated[2] animals which occur everywhere in close contact with man and which may likewise be unafraid of him.

2. *Fear vs. Startle.* We assume that an animal is afraid of man when it repeatedly flees when he approaches it. We mean by fear no more than that. We recognize, at the same time, that this simple *behavior* criterion is not entirely adequate. An animal, for instance, may possibly flee because other animals which compose the group with which it has been associated from birth also flee. Under *other* conditions, however, there may be no fear. That is to say, when it is alone the animal may be approached. By fear in a normal man we mean whatever impulsion or desire

[1] We shall later refer to Lashley's animals which, when physically disabled, turned instantly to new forms of behavior which they had never used previously.

[2] Gault and Howard remark in this connection that the fear instinct has all but disappeared from domesticated cattle, horses, and sheep! (P. 190.)

to escape or to flee he may observe in connection with some dangerous situation together with whatever actions he may show in accordance with this desire. But we do not class fear with startle. An individual may be working at his desk, or he may be reading in his home, or he may be just falling asleep in bed when someone shouts in his ear. He may be startled and, possibly, angered. But there may be no fear unless he finds that the shouting object is also dangerous or harmful.

We do not mean to imply, in any sense, that animals which have not previously shown fear in some situation cannot be made to show it. Whenever an organism suffers pain and injury, fear may appear. Where there is full understanding, fear may be lacking although a situation may be very painful. Such understanding, however, is not commonly found among animals and little children. We assume, therefore, that to induce fear in an animal there must be something in addition to the purely visual or auditory stimulation of the animal. The situation must include more than seeing and hearing. We have seen animals, for instance, raised in fields adjacent to railroads, which were completely indifferent to the sight and the sound of the passing trains. Again, a man may possibly startle his dog or his child time after time by suddenly shouting or jumping at it, but, unless he hurts it, it does not flee in fear from him.

Some kinds of animals, which from their birth have been reared in close contact with man and which have not been seriously harmed, are recognizably unafraid of him. But, interestingly enough, other kinds of animals which develop in an environment entirely removed from any possible influence of man may, upon first contacts, show either much fear or no fear at all of him. We assume in the first case that if there are *non-human forms present in their environment which prey upon them*, the animals, although they have not previously been in the same environment with man, will be afraid of him at first. On the other hand, if there are *no predatory forms* living in the same locality with them, of whom they are afraid, animals will not fear human beings at the time of their first contact with them.

3. *Skunk and Porcupine.* There are some very interesting facts which appear to bear directly upon this general problem of the possible existence of a fear instinct in animals. We can indicate only a few of them. The ordinary skunk, common

throughout this country, has no non-human enemy.[1] It is seemingly unafraid of man. As a matter of fact, it will actually walk without apparent concern or undue haste through a school yard where children are at noisy play.. Moreover, the porcupine, as every one knows, is the only animal in the North Country which man may easily approach and kill with a club. Because it may be the means of saving the lives of men who are lost there, it is rigorously protected in such places. Like the skunk, it is not afraid of man; and it, too, has no non-human enemy.

4. *Penguins.* Many explorers, who have written of various animal forms to be found in environments which were wholly lacking in predatory forms, have repeatedly remarked concerning their surprising tameness, or lack of fear.[2] Penguins, for instance, furnish a striking illustration of this point. Scott [3] observed them in the waste areas of the Antarctic. Of the behavior of these odd creatures toward their very first human and animal visitors, he wrote: "They waddle forward, poking heads to and fro in their usually absurd way, in spite of a string of howling dogs straining to get at them. They come a few steps. The dogs make a rush as far as their harness allows. The penguins are not daunted in the least. The final, fatal steps nearer are taken. There is a spring, a squawk, and a horrid red patch on the snow. Nothing can stop these silly birds. Members of our party rush to head them off. The penguins only squawk and duck."

5. *Albatross.* Beebe,[4] who visited the Galapagos Islands, has given some very illuminating glimpses of the various forms of life to be found there. Some albatross were nesting at the time. He walked up and gently pushed one of the great birds back until the egg was uncovered. He then took it up, examined it, and replaced it. The parent, with no show of resentment or worry, shifted slowly forward, opened wide her breast feathers and gently sank close down upon it again (3, *110*).

[1] In some sections of the country, the great horned owl may possibly attack; it is not definitely known. But it is known that is has no ground enemies.

[2] The student is referred to the British Mt. Everest Expedition and to the reports of Collins concerning life on some of the islands off the coast of Alaska.

[3] *Last Expedition.*

[4] Beebe is the scientist who has descended so far into the depths of the ocean in the bathysphere in his study of marine forms of life. He is Director of the Department of Tropical Research of the New York Zoölogical Society.

6. *Mocking-Birds and Sea-Lions.* When he landed on one of the islands, three mocking-birds ran toward him. He was both surprised and charmed, he remarks, by their tameness. There were two old birds and a young one still in its baby plumage. The two older birds stopped at a short distance, but the young one came on and picked a grain of wet sand from his shoe. As Beebe walked on slowly the birds kept him company (2, *69*).

The behavior of the sea-lions was also quite interesting. "On a flat rock," he reports, "I saw a big mother sea-lion nursing a husky youngster. She looked at me curiously, but made no movement until I rolled her off into the water, when she swam high out to see what next astonishing thing I would do. I took her pup and threw him high in the air. He fell into the water with a squawk and a splash and almost with a single movement of his tail shot himself out upon the rock at my feet, croaking as if to say, 'Do it again.' No tameness of horse or dog has ever impressed me with anything like the thrill which these creatures gave, in accepting the first human being they had ever seen as something which it was inconceivable could harm them" (2, *288*).

7. *Baby Seal and Birds.* He was engaged one day in breaking off a shell under water, he reports, when suddenly he got a tremendous shock as he felt a warm, rubber-like substance press gently against his hands. He leaped back and a baby seal rose directly in front of him. He went back to his work and four young seals then gathered in a circle not six feet away watching every movement. Again and again, one would swim forward under the water and nuzzle his fingers. A few yards away adult seals lay asleep. He could go up and push them without any resulting fear or disturbance becoming apparent (2, *104 ff*). Beebe makes this comment in this general connection: "By far the most noticeable effect of insular isolation upon the birds is psychological." The extreme tameness of all except the migratory forms is significant. The student should readily understand why the migratory forms were afraid of the members of Beebe's party while the native forms were not.[1]

8. *Is the Relation between Lack of Enemy and Lack of Fear a Coincidence?* An interesting question immediately arises concerning the behavior of these various creatures, some of which

[1] The student is referred to Beebe's excellent descriptions, p. 81, *Galapagos: World's End.* G. P. Putnam's Sons.

live comparatively isolated lives — at least as far as man is concerned — while others live closely associated with him. The skunks, the porcupines, the seals, the mocking-bird, the albatross, as well as various other creatures, which have no serious predatory enemies, are astonishingly unafraid of man. Is it sheer coincidence, we must ask, that these many creatures, which live in environments such that they are not harmfully molested, *are apparently quite fearless?* Can we properly assume that nature, as a result of some unknown reason, has signally failed to equip these several species of animals with some mechanism for avoiding harmful objects upon first contacts with them? Or, shall we simply assume that they are wholly unafraid in the beginning because they have never, as individuals, met any living creature which greatly harmed them; that is, they have never fled from harmful objects? It occurs to us that the most sensible explanation will admit that such animals are *fearless because they have not had a fearful personal history in which discomfort and pain were suffered as a result of contacts with other organisms.*

We suggest, therefore, that animals as well as human beings which live in one kind of environment develop patterns of fear behavior, while those which live in another kind of environment develop patterns of fearless behavior (tameness). In neither case, however, do we regard the environment as inhibiting or as modifying any particular fear instinct. From this general position, fear itself is not considered as being a form of instinct or of direct instinctive determination. It comes instead from observations of pain and discomfort directly resulting from activities of an organism with respect to its various environmental agents. Where there is no pain or harm, there is no fear. Regarded from this position, the ancient account in the Old Testament concerning animals that were at first unafraid because no harm was inflicted upon them would seem to have much truth in it. Figure 4 shows lion, tiger, and leopard cubs living together without strife. Among these particular animals there is no preying or being preyed upon. One of the greatest animal trainers[1] of all time has written of a close circus friendship between two great beasts, the lion and the tiger. Here is a case of two species which are commonly

[1] From an article by Clyde Beatty in *Pictorial Review*, March, 1934. He also tells of using a group of 40 animals in one enclosure. In this group were lions and tigers — both male and female.

regarded as being deadly enemies. But common conditions under the "Big Top" made them friendly.

f. Absence-of-Choice Activity. It would also appear that there can be no choosing whatsoever in so far as instinctive behavior is directly concerned. Because the bodily mechanism of instinctive behavior is presumably predetermined by the race or the

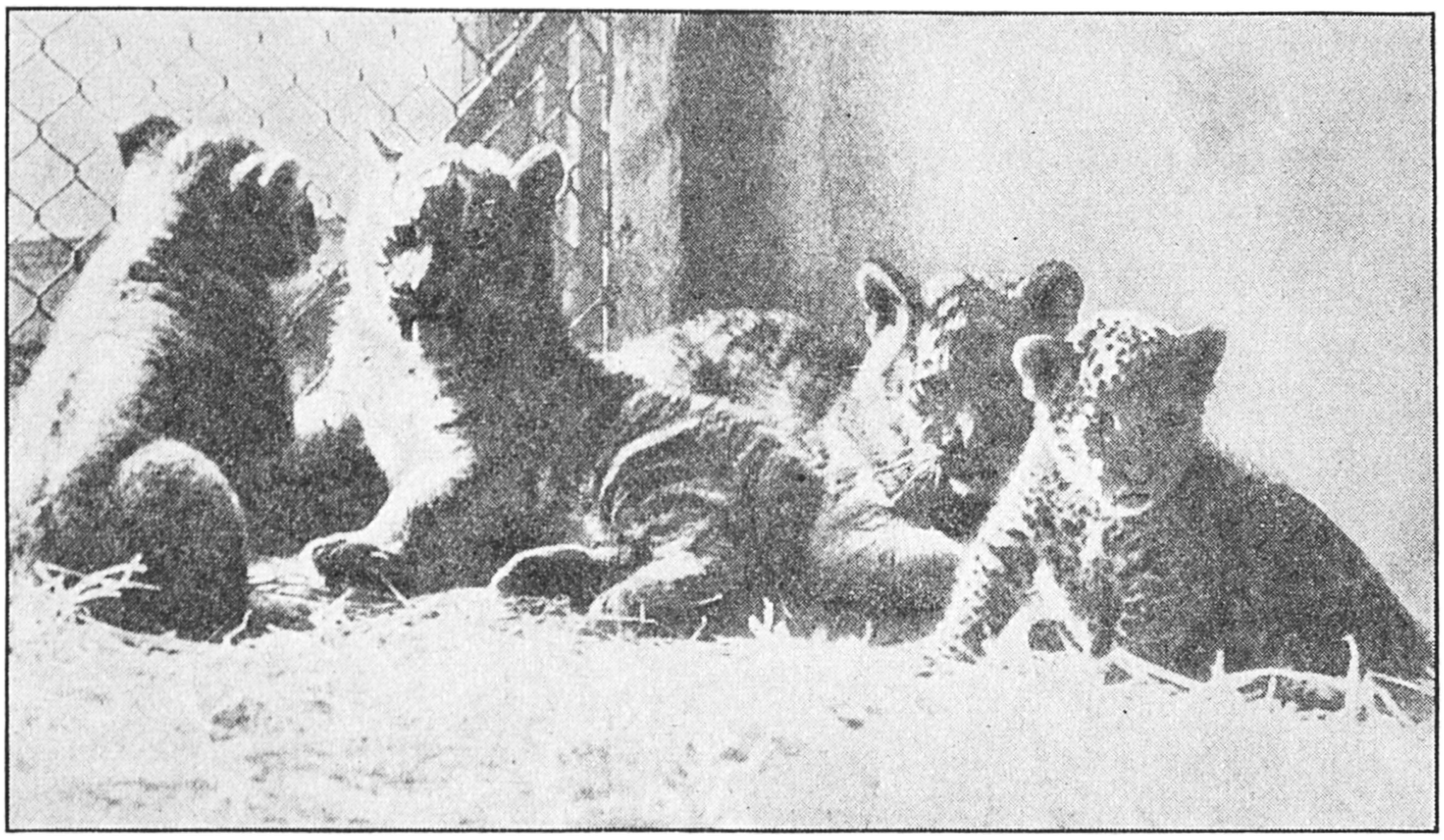

FIG. 4. Can you explain why the young of different species may live peacefully together?

species and transmitted to the individual, an individual naturally performs in the way it has been created to act. A number of years ago James remarked that an instinct is utterly mechanical in its expression. We find the same position taken more recently. A fixed instinct, we are told, seems to work mechanically, as do many habits. Not only does consciousness not direct the activity, but so long as everything goes smoothly, there is little or no consciousness. Where acts are to be repeated over and over, the same kind of movement is made in response to the same stimulus, consciousness is unnecessary. Instincts, in so far as they are purely instinctive, are always blind (11, *56*).

Choice behavior, therefore, does not appear to be carried on at a purely instinctive level. Some particular psychological ability other than perceiving and acting — in so far as these two functions are involved in a given instinct — must necessarily be concerned in every performance in which some choice is made. Choice, as we shall later show, implies the consideration of two possible

goals or two possible types of satisfaction ; the weighing or balancing of alternatives. This necessarily means deliberation, hesitation, and inaction. We seriously question the possibility of choice below the level of men. Among subhuman forms, action appears to be largely unequivocal. The organism strives always to satisfy its instinctive needs, — the stronger need always dominating the weaker. When one way is blocked, another way is tried. There is seemingly no consideration of any consequences. Psychologically speaking, we regard the behavioral expression of instinctive need below the human level much as Loeb did the tropism. According to Loeb, animals which behave tropistically do not choose to act with respect to a particular situation any more than they choose, for instance, to grow. We say that man himself does not choose to be hungry, thirsty, or fatigued. Man is able, at least within limits, to determine the order and the manner in which two inherent needs which are simultaneously present shall be satisfied. He is able to control both the time and the mode of satisfaction in the light of the possible future consequences. Man and an animal differ greatly in this particular respect. The former is unquestionably able to evaluate the present in the light of the future; the latter, however, is conspicuously lacking in this characteristic.

g. **"Natural" Ways of Attaining Certain Ends.** Instincts are commonly assumed to imply the existence of some natural end or purpose to be attained by the organism through the operation of its hereditary patterns. The value of any instinct to the race or to an organism is accordingly determined by the degree to which the latter is adequately motivated toward the carrying out of some particular activity in a certain way in order to achieve a natural end. It is assumed that there must be some essential feature of instinctive behavior which possesses biological utility; that is, every instinct must be useful. Moreover, this *predetermined* and natural way, according to this general position, may be greatly modified; many unlike changes may actually be made in an instinct. Figure 5, for example, furnishes a good illustration of this matter of alleged instinctive modification. Yet we must point out that if the instinctive pattern is definitely laid down as a hereditary characteristic of a species, little or no modification of it would actually be possible. In this connection we are reminded that "if we assume strict accuracy for the statement

that an instinct is an innate or natural urging or impulsion toward the attainment of some object, it would be impossible to show that it undergoes any modification whatever. It would probably be a safe hypothesis that such instincts are unmodifiable" (10, *188*).

There is, however, a more sensible way of considering this particular matter. If an individual does not *assume*, in case of any given instinct, that there must be some particular pattern which aims directly at the attainment of a natural, hereditarily determined end other than that of sheer satisfaction of some need, he will then expect to find only that type or pattern of behavior which the interrelated factors of *heredity*, *environment*, *and personal history* are actually able to produce. He will recognize, therefore, that the behavior of an animal or of a human organism toward an object must always be regarded in terms of these three factors. Any activity of an organism whereby some degree of satisfaction is directly derived then becomes more understandable without necessarily having to be regarded, even in extreme cases, as being *peculiar*, or abnormal or unnatural. Let us consider some illustrations.

1. *St. Louis Lions.* A short time ago, some men in St. Louis wished to hunt lions. But they did not want to go to Africa to do so. They accordingly secured some lions which had formerly been in a circus and transported them to a remote, woody section of the country where they intended to release them and, after a time, hunt them. But in all their planning they did not provide for the *history* of these *particular* lions. When the cages which contained the animals were finally opened, the men actually encountered no little difficulty in forcing the creatures to leave them. The latter apparently were not at all eagerly waiting the proffered opportunity to rush from their restraining cages to the shelter and freedom of the heavy undergrowth of the country-side. Finally, by means of hard prodding and by quickly closing the doors after them, the lions were "freed" from the boxes. Instead of the keenly anticipated fun of hunting dangerous lions, the men discovered that the creatures lay quietly under bushes near the cages.[1] Here they were finally and necessarily slaughtered quite like pigs in a pen. Here is an interesting case. Can we understand this behavior?

[1] Nelson, who doubled in the Tarzan pictures, reports that "when the scene calls for a lion to run across in front of the camera, it is only necessary to place the cat's cage opened where he can see it. He'll do the run — right into his cage."

An individual can assume, of course, that whatever *natural* and *unmodified* instincts these particular lions might once have possessed that would cause them to fear man, or to kill man, or to escape and hide from man in the undergrowth had either long since disappeared or had been *modified.* He can also assume that, as a result of the working of some particular instinct, there exists a particular right way to respond to a particular environment, and that, because these lions which had been reared in a circus failed to respond as they theoretically should when given their chance, this instinct has either disappeared or been modified. But another individual, we hold, may quite properly assume that these creatures did not possess, even in the very beginning, any instinct to fear or to kill man, to escape and to hide from man. We shall assume, therefore, that the lions really acted *at all times* as they actually should under these specific historical and environmental circumstances. It may be rightfully maintained in all such cases as these that there is really no instinct of a *specific* nature either to disappear or to be modified; that, in short, there is no right or wrong — natural or unnatural — way to act.

Of these two ways, the first with its emphasis upon natural, predetermined patterns definitely stresses heredity. It holds (a) that nature originally provides a way to do something or to reach some end, but (b) that the environment may greatly modify this way. It holds that if development of the organism were actually permitted to take its course without being hampered by some unnatural environment, every behavior pattern would really be natural. The mistake here lies in the original assumption that the behavior of a creature can be fully understood by considering it apart from the character of the environmental relations. The second way, on the other hand, attempts to explain behavior in terms of the heredity, the personal history, and the environment of the organism. It suggests the utter impossibility of understanding the activity of an organism when it is divorced from its environment. This way recognizes that the environment is a very necessary *causal* factor in the final expression of any form of activity. It cannot be regarded, therefore, as an agent that operates either *passively* to allow the intra-organic or hereditary conditions to express themselves, or *actively* to inhibit or to produce *modifications* in something which is really predetermined. It holds that because it has functioned in a particular manner

in a given environment, an organism assumes a definite historical complexion. The functional effects linger. The organism is unquestionably different from what it would have been if it had lived and behaved in a wholly different environment. The one way, therefore, is as right or as natural as the other. To make our position quite clear, we say that sex behavior which appears in a boy or girl, because such has been discovered under particular conditions to be satisfying, is as natural as any other form. If an individual has developed just *one* way, that way is right for him. Under other conditions, another way may be right.

2. *An Illustration of Cats and Rats Reared Together.* Some interesting experimental evidence bears directly upon this point of the significance of the environmental and historical factors in life activity. Some ordinary house-cats were experimentally reared with white rats from their very earliest days to the age at which they were finally tested (Fig. 5). At the same time, other cats of the same birth age were reared in a wholly dissimilar situation — one into which no rats of any sort were permitted to enter. These latter cats were consequently quite "uneducated" as far as rats were concerned. Fifteen cats with the first kind and eleven cats with the second kind of personal history were then placed together in a common environment. A third group of cats which had had a history different from that of each of the other two was then placed with them. This last kind of animals when given an opportunity would quickly kill and eat rats in the very presence of these other two kinds of cats. Under these experimental conditions, of the *fifteen* cats which had constantly associated with rats throughout their entire history, only one (7%) killed a rat. And this rat was of a different stock from that with which the cat which killed it had been reared. These animals, therefore, did not kill a single rat of the sort with which they had become thoroughly familiarized. Of the eleven animals which were historically "naïve," as far as association with rats was concerned, nine (81%) killed rats (Kuo). The first (historical) sort of cats had never killed rats; and they did not kill them, even when other cats around them did. The second sort of cats, too, had never killed rats. But they knew nothing whatsoever about rats until they saw them being killed and eaten by other cats. Most (81%) of them accordingly killed rats. The first sort of cats had been definitely prepared as a resultant of a *partic-*

ular environment and history against killing rats; but the second sort had not. The former "resisted"; the latter did not. The one continued the same old relations with rats; the other started its association with rats by killing them. Now, one is certainly

FIG. Does this prove that a killing instinct has been successfully inhibited by a maternal instinct

not justified in assuming that the first kind of cats had an instinct to kill rats which was restrained or modified through its association with rats. Nor can one properly assume that the cats in the one case choose not to kill, while in the other case they choose to kill. Failing to kill is actually as characteristic of cats of one life history as killing is of cats of another life history. Each is found to be quite natural when sensibly considered. In both cases there was the inherent need for food, but the ways of satisfying it were very

different in the two kinds of cats. The one was neither more nor less instinctive than the other way.

h. Perversion and Reversion. Under this general topic of natural ways we wish to refer to another implication, *namely*, that the concept of *modified* instinct may directly lead to the notions of *perversion* and *reversion*. If a student should assume the existence of a natural (proper) end for a particular instinct, then any suppression or modification of the instinct may be interpreted as eventually resulting in: (a) the organism's being forced to show an unnatural or a wrong form of activity (perversion), or (b) the organism's returning to a more natural — and perhaps more primitive — form of activity whenever an opportunity to do so is afforded (reversion). (a) Regarded from this general position, perhaps any form of sex behavior, except that which directly serves the biologically intended ends of race perpetuation, may possibly be regarded as being a perversion. But no small degree of unhappiness may directly result from this notion of sex. Where sex is made to serve only one proper purpose, *namely*, that of biological reproduction, the possibilities are rather large that personal injury and great unhappiness may result. Biologically speaking, there can be no doubt concerning the significance and the rôle of sex. It is a way of perpetuating a stock. Man, however, does not live at a strictly biological level. Many animals possibly may, but human beings ordinarily do not. Some religions, for instance, stand strongly against birth control. They hold that sex has but one *natural* end. It is intended for the production of progeny. This deliberate importation by religion of a natural, *biological* attitude into the psychology of sex has unquestionably caused a great deal of personal unhappiness as well as social and economic injury. It is difficult, indeed, to understand how sex relations must necessarily be wrong, where no biological end is directly served. Every informed individual must surely recognize that various societies in different parts of the world have wholly unlike attitudes and standards regarding sex. Each particular group determines the particular types of behavior which it accepts as being right or wrong. Various forms of sexual behavior which may unquestionably be regarded by one group as being wholly wrong (perversions), may not be so considered at all by another group. The understanding student is referred in this connection to the "Golden Age" of Greece.

(b) Again, if some creature changes its behavior toward man — becomes afraid after it has been free for some little time from his influence — it may be regarded as having reverted to its natural state. Any animal — dog, horse, hog — if placed under life conditions in which association with man is lacking for a time, will usually show some change in its behavior toward him. Being a developing organism, its activities gradually change. The nature of the changes is actually determined, in part, by environmental conditions. It is not surprising to find such changes; it would, indeed, be surprising if they did not occur. An animal develops one set of activities when it associate with man and another set when away from man. One is no more natural than the other. There is no sensible reason for assuming that there is any instinctive urge or modification of instinctive urge which expresses itself in the behavior of an animal in a non-human environment to result finally in a *reversion*.

Man, too, is often said to *revert* to savagery. We occasionally hear, for example, of human beings who eat their fellows, when all other food is gone. Individuals frequently point to such cases as evidence of man's tendency to revert to a more natural state under certain environmental conditions. They appear to regard man as being at heart a *real savage* from whom the thin veneer of civilized disguise may occasionally be stripped under contact with a more primitive environment. We can, however, say this: Under certain environmental conditions, where an organism is very strongly motivated by an unusually insistent need and where the former modes of satisfaction are impossible, new ways of securing satisfaction may sometimes appear which may be quite unlike the patterns characteristic of the organism when its needs or its environmental conditions were considerably different. While we may not hold such behavior to be desirable, yet our understanding is in no way furthered by any explanation that stresses *reversion* or modification of instinct. The tragic ways of life are not marked by guide posts. There man often stumbles ahead to whatever awaits him. Those who have in imagination followed the members of some ill-fated expeditions have been inexpressibly shocked to discover them devouring their own kind. Yet the thoughtful individual, before he passes final judgment, must surely weigh the several causal factors necessarily involved in all such cases.

i. Delayed Instincts. Another common implication should be recognized, namely, that an instinct may be considerably delayed in making its influence felt upon behavior, that is, it may appear for the first time when an organism — a human being — is several years old. Concerning this possibility, we are told by one student, that if an instinct is not present at birth it need not necessarily mean that it cannot develop later. Just as bodily organs may possibly develop some time following birth so likewise the connections in the nervous system upon which instinctive actions depend may lie *latent* for a number of years and come to maturity when adult life is attained. "Sex instincts," thus one writer remarks, "might well be expected to fall in this class as might walking and the more general social activities" (21, *114*). We recognize that instinctive needs differ greatly when regarded in terms of the ways in which they may be satisfied. The way of satisfaction is a necessary and inseparable part of the whole instinct. We know that each appears under a complex set of conditions. Thirst, for instance, presumably arises when the water content of the organism falls below an inherently established level. If the intake and outgo of water could be rigidly regulated, an organism would never be thirsty. We assume without question that when the proper causal conditions for instinctive behavior exist, the behavior appears. The possibility of satisfaction is not present at all times. Mating as one form of sex satisfaction does not usually appear in the human being until it is several years of age. But we cannot agree, however, that the sex instinct does not appear — that it is delayed — in the average individual until late childhood or early adolescence has been reached.

1. *Sexual Satisfaction among Children.* As a matter of fact, we know beyond reasonable doubt that the possibilities of securing sexual satisfaction exist quite early in the life of a human being. The individual of a few years of age may actually obtain no small degree of sexual gratification. The understanding student need not go beyond his own observations of human behavior to confirm the full truth of this statement. Should he have any further doubt he can turn to the data obtained, for instance, from a study of American College women upon their personal sex practices. These facts reveal that about 42 per cent started autoerotic sex practices between the ages of five and eleven years (Blanton,

Child Guidance, 1927). The evidence indicates, in general, then, that the most outstanding and significant change which appears without teaching in the sex life of a developing individual does not actually concern a shift from a condition of *no sex to one of sex;* the possibility of sexual satisfaction is always present under certain conditions in most human individuals. It is an inherent — but not peculiar — characteristic of the human race. Sex development, when properly considered, is discovered to be mainly concerned with a shift from the individual itself to some other individual as the actual *source* of gratification. The various and significant sex meanings which, under the general conditions of development from a child to an adult, come to characterize other individuals, finally produce in most cases an individual with a decidedly different mode of securing satisfaction. As a result of its development, the individual definitely turns away from itself to others. No profound *biological changes* necessarily occur in any way in this case. There is, simply speaking, either a partial or a complete shift in the direction of the individual's energies or activities. The old form or way of satisfaction may possibly remain, and a new form may be added. Or, because the old form is *less satisfying*, it may be completely dropped. Or, the two ways may alternately rise and fall. No person with an understanding of life attempts, however, to maintain that a sex instinct must suddenly appear when a developing individual has reached the age of 5, or 10, or 18 years.

2. *Proper Recognition of Such Facts Is Desirable.* Because of these obvious facts, as well as many others, we wish to suggest that both common sense and scientific necessity demand a proper recognition of the existence of sex needs and the possibility of gratification under certain conditions, during the pre-adolescent years of an individual's life — at a time so early that there is little or no possibility of biological mating and reproduction. As a matter of fact, certain sex experiences may appear at an age such that mating behavior would ordinarily be regarded as being quite unusual. If the facts in this particular connection are duly considered, much benefit to human life should directly follow. Intelligent and sympathetic guidance, when applied during the early years of life to an individual whose only possible fault may lie in his possessing considerable potentialities for sexual gratification without having, at the same time, a sufficient degree

of development to understand its larger significance, may aid materially in preventing the establishment of fairly permanent sources of sexual satisfaction *within* the individual. We suggest then that sex be regarded, biologically and psychologically, as an inherent characteristic of human life. It exists from the very beginning. While the particular forms of satisfaction may indeed vary widely due to opportunity, tuition, or chance discovery, the need nevertheless remains. It is both persistent and insistent. In the absence of one form or one way of gratification, another form will usually appear. Sensible control must necessarily be aimed at the way or the mode of satisfaction. It must be directed at the expression of the need — not *at its inherent basis.* It is probably no more easy to remove sex entirely than it is to remove hunger and thirst. And it is, perhaps, no more desirable. It is certainly true, biologically speaking, that sex is neither good nor bad.

3. *Locomotion.* Let us consider the case of walking. The assumption of a walking gait, it would appear, may be adequately understood in part as being a more satisfactory way than crawling, inasmuch as an individual is enabled to get from one place to another at a faster rate. As a result, the period of time which has to elapse before satisfaction is secured may be considerably shortened. If walking were not more satisfactory than other modes of locomotion, an individual would probably never walk; he would continue to crawl. Human beings apparently continue to crawl in order to get to environmental objects (1) until they reach a period at which their *legs* are sufficiently strong to support them in a standing (walking) position, and (2) until their cortical patterns are adequately developed to guide and direct the movements of their legs in walking as they do in the case of so many other activities occurring during the later years. Many forms of crawling appear. Each form is a product of a set of causal conditions such as desire, strength, co-ordination, and balance. Where the legs are unusually strong but the trunk is weak, individuals will often run on "all fours." This mode, however, does not possess any particular biological significance.

Now, students often confuse *control* with instinct. We regard the control which must necessarily exist in walking as being of essentially the same order as that which exists, for instance, in standing, in bending, or in hopping on one leg while kicking,

pushing, or holding with the other. Here, as in every case, control comes gradually. It is the direct resultant of brain and muscular development. When established, however, a great *variety* of actions is at once possible without further development of brain and muscles and without the necessity of specific learning. The control which makes walking possible is no more peculiar than that which makes possible many other actions which involve the legs.

There is no evidence whatsoever which indicates that a child has an instinct to walk and that *before* it actually walks it expresses this instinct by making particular leg movements like those involved in walking. Nor does any such instinct really explain what the child does when it finally walks. We assume that it is no more strange for a child to change from a crawling to a walking type of locomotion than it is for an adult individual, who wishes to move through low places or to approach an object without being seen, to change from a walking to a crawling gait. The goals may be different, but it is impossible to explain either in terms of a particular instinct. A child walks because it definitely wishes to get to some place — because getting to some place satisfies its inherent needs — and because it has enough strength and control to walk there. The organic structures, the needs which can be satisfied, the developing strength, and the increased cortical (brain) control are inherently determined. But their use or their mode of expression varies greatly among different

TABLE I

HEAD	Lift its chin .	first month
	Raise head and chest	second month
TRUNK	Reach . .	third month
	Sit when aided	fourth month
	Grasp objects	fifth month
	Sit (high chair)	sixth month
	Sit unaided	seventh month
LEGS	Stand when aided	eighth month
	Stand by clinging	ninth month
	Crawl . .	tenth month
	Walk when aided	eleventh month
	Rise by clinging	twelfth month
	Climb stairs	thirteenth month
	Stand unaided	fourteenth month
	Walk unaided	fifteenth month

individuals. Some individuals never crawl, while others crawl beyond the average age. Some individuals walk at an early age, while others walk at a very late period. Any one factor may play a major rôle in determining what is done. Table I shows the order in which various behavior patterns tend to appear. The direction of the shift as indicated here is quite typical. The head-end dominates the total developmental pattern. The major determining factor in this sequence is evidently inherent. Thus we may adequately account for its general uniformity among large groups of individuals. Aided, the child will walk at one period; unaided, it will walk at another.

j. Disappearance of Unexercised Instincts. A fifth implication may be stated in this manner: If an instinct is not exercised at its proper — that is, its natural or predetermined — time it tends to disappear. Of this point, Pillsbury writes in part that instincts which are not exercised at or near the time the animal matures to the stage at which they normally present themselves, may entirely disappear. An observation by Padilla shows this clearly. Chicks which had been fed in the dark for fourteen days and which were then brought into the light and surrounded with bits of food made no attempt to peck. Eighteen of twenty-one actually starved to death because of this failure of the normal response although surrounded by plenty of food (p. 115).

We wish to offer two suggestions upon this particular problem. From our common knowledge both of the usual persistence over long periods of such hereditary motives as hunger, sex, thirst, and of the various attempts of organisms to satisfy them, it indeed seems strange that the animals mentioned here should have refused to eat by pecking because they had been fed by man during the beginning period of their lives. It is certainly true that mammals which are spoon-fed by man during their first days will suckle when deprived of other ways or forms of feeding. We commonly assume that actions which an organism has clearly *learned* tend on the whole to disappear rather slowly. In this particular case, however, the normal pattern of getting food by pecking, which Pillsbury regards as being hereditarily determined in the chick, was in two weeks' time apparently so completely lost through a lack of exercise that the animals actually starved to death. They could not feed themselves. But it seems to us that a somewhat more plausible explanation of this striking

failure to behave in a way that one might legitimately expect, can be put in terms of abnormal vision and inadequate experimental control. Two factors were *simultaneously* changed here. On the one hand, there was a change from darkness to light, and on the other hand there was change from being fed to self-feeding. Before one can properly evaluate the results obtained under such conditions, he must know something about the effects which might follow a change in *each* of the two variable factors. Self-feeding involves vision. It is quite possible that the two weeks which they spent in darkness produced serious visual and organic disturbances in the chickens. Such disturbances might very well explain their failure to peck and to take food when given an opportunity under illumination.

Chickens Which Do or Do Not Follow. We wish to cite one other illustration which bears upon this assertion that an instinct disappears if it is unexercised. If newly hatched chickens are kept entirely away from their "mother" for several days, they will not immediately follow her or any other hen upon being given an opportunity to do so. If they are fed outside an enclosure during this time by a human being, they will follow the human being. If they are fed in a pen, thus preventing their following the feeder, they will not follow any object. They will, however, *go with each other* if they have gotten food together. It would appear evident, judging from various facts at hand, that there is no hereditarily determined pattern in the young chicken by virtue of which it tends to perceive and to act in a definite way toward *any non-food object.*

But the young chick, if given an opportunity, will go with the creature that feeds — satisfies — it. At any time during their lives if another creature necessarily satisfies their hunger, they will go with that creature. Moreover, should the object — human or non-human — that previously satisfied it, now cease to do so, the chicken will shortly sever its relations with the object. Again we do not assume that a particular instinct has to exist and be *modified* in the chick in order to account for this sort of behavior. We assume that any creature which is dependent upon its parent for the satisfaction of its needs will desert the parent when the source of satisfaction changes. Where the dependence of one creature upon another is based solely upon hunger satisfaction, separation is more likely to occur fairly early. We may legiti-

mately maintain, to make our point clear, that a human being may establish many new or may break many old relationships with other individuals because of the nature of the satisfaction derived from such associations. Marital relations, which are constantly being broken on every side, may be cited to illustrate this point. We find it unnecessary to fall back upon the assumed existence of a particular instinct, which may be modified in some manner, in order to have an intelligent explanation of these actions of man. Nor is it at all necessary in many cases of the subhuman organism.

We can say, in general, of this problem of instinct that, in various situations to be found at the subhuman level, we may discover a certain degree of specificity between particular environmental objects and particular forms of behavior which cannot be adequately described solely in terms of learning, and which we assume to issue in part from an inherent condition of the organism. In these cases it is not at all clear whether the specificity appears *directly* as a result of some definite form of functional determination or *indirectly* as a result of some peculiar bodily structure of the organism that serves greatly to restrict its activities, so that an organism must necessarily act, if at all, in a very precise way. That is to say, heredity may conceivably lay down, in the first case, a specific *pattern in the nervous system* by virtue of which the organism must necessarily function in a definitely limited manner. Or, heredity may, in the second case, produce certain peculiar bodily organs and structures which in turn work, if at all, in a very specific manner. The apparent specificity with which an animal may act, upon being placed for the first time in a particular situation, seemingly points toward the possible operation as a hereditary contribution of some neural mechanism established in connection with some need. Out of a total situation, in which an organism with a definite need faces some object which has certain properties, there issues some instinctive expression. In each case, however, we may well recognize the importance of the environment and the personal history of an organism as determining factors in its behavior. The psychological characteristics of any living creature can be adequately understood only in terms of its history — both hereditary and personal — and in terms of its relations to the properties of the things which surround it at any given moment.

A fuller comprehension as well as a larger appreciation of the psychological activities which are to be found in all forms of animal and human life must necessarily come with a proper recognition of (1) the importance of the kind of protoplasm which composes each type, (2) the significant characteristics of the environmental conditions under which they as individuals have spent their lives, and (3) the specific nature of the personal history of each individual organism. The relative importance of each of these factors apparently varies from individual to individual and from species to species. Where a *like protoplasm*, a *like environment*, and a *like history* are to be found, we commonly find strikingly similar behavior patterns among a large number of animals. Where considerable differences in any *one* of these several factors exist, animals may be strikingly dissimilar. Moreover, a common history may make *unlike* species — different heredity — somewhat alike. It is seemingly fruitless to look to any single condition for a complete explanation of all behavior. In all those cases where hereditary conditions can be shown to serve as a major factor in guiding the behavior of an organism and its kind along fairly specific lines with respect to specific objects, we can safely speak of instinctive determination.

k. Sex and Hunger in Man. According to that interpretation of behavior which is commonly found among the many students who have followed closely the thinking of Darwin, Huxley, and James, man apparently possesses many instincts. "Man," one individual remarks, "has more instincts than any other animal; but the variety of action possible to him, and the modifications produced by experience, make it seem as if he had none. We must remember, however, that his purely instinctive actions are just as blind as those of the bee" (11, *58*).

We are quite unable, however, to discover in the various activities of human beings that degree either of specificity or of blindness which is thus associated with the notion of instinctive behavior. We recognize, of course, that man normally perceives many different kinds of objects; that he shows many dissimilar forms of activity; and that he manifests many unlike emotions. But it is quite impossible, nevertheless, to reduce his life to that degree of simplicity commonly found to be characteristic of the behavioral patterns of subhuman organisms. Man, in common with a great many animal forms, unquestionably possesses various fundamental

basic *needs*, or desires whereby satisfaction may be obtained. Moreover, these are very *insistent* and *persistent*. In so far as such needs or possibilities for satisfaction may also be correctly regarded as being *inherent* characteristics which affect various life activities, *we shall regard them as being instinctive*. But we also recognize that man is not definitely restricted to some one specific mode of *satisfying* these several needs. He differs very sharply in this respect from his many subhuman neighbors. He shows a much larger number of unlike ways of gratifying his various inherent needs than any other living creature does. In fact, he outranks all subhuman forms in terms of his variability and his versatility in intentionally creating life situations which directly contribute to his own gratification. Certain of these satisfying modes — some which are connected with sex — may have absolutely no usefulness when regarded in a strictly biological sense. They may, however, possess unusual psychological significance. When they appear, either through chance *discovery* by the individual himself or through direct *instruction* or teaching by others, and become forms and sources of satisfaction in the life of an individual, they may be completely sufficient within themselves.

As a result of the very nature of his protoplasm, man observes such characteristics as hunger, thirst, discomfort, fatigue, sleepiness, and sex needs. Each of these arises under certain conditions both inside and outside the organism. While man exercises considerable control over their behavioral expression, he cannot say as much for their persistence, appearance, insistence, and their direction. In these biological conditions, there exist some very significant sources of persistent motivation for the various psychological activities of the human organism. Any one of these several conditions or characteristics of a human being may be directly accompanied by varying degrees of general dissatisfaction and restlessness. At times, an individual may not be at all sure concerning the exact nature of some general disturbance which arises from one or more of these sources. This would seem to apply especially to the more naïve individual as far as his sex needs are concerned. He may recognize, for instance, that he is unable to remain working quietly at some task; and, that he is both dissatisfied and discontented. He moves about here and there until he discovers some way of securing satisfaction. He may then hold to this particular way, or he may later discard it for another. Or, he

may possibly possess at the same time two or more unlike modes of satisfaction. Figure 6 shows a form of apparatus used with animals in the study of the strength of sex and hunger motives.

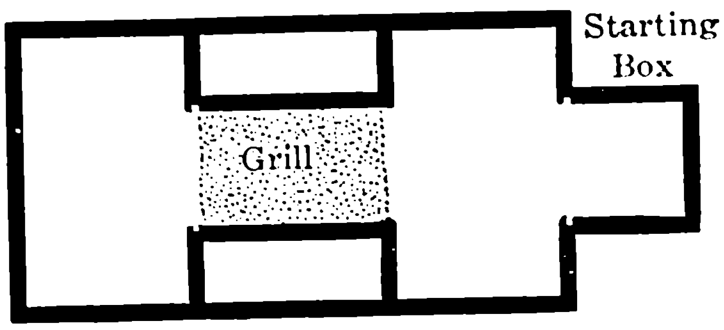

FIG. 6. A form of apparatus used in studying animal drives.

It may also be true, in some cases of hunger, that man is not quite certain concerning the nature of his determination. An adult human being may be hungry yet be unable to relate his need to any particular object or thing. We can properly assume that an infant, for example, may be hungry without being hungry for any particular object. That is, it may definitely observe certain properties of its organism, *namely*, hunger, just as it may observe pain. Because of its hunger, it acts differently than it does when it is not hungry. It is restless. This restlessness is shown in part in the mouthing movements which it makes even when there is nothing in its mouth. It is definitely assisted by others in finding satisfaction. As it grows older, it may conclude, if it pauses to consider the matter at all, that it was hungry. In this, as in other cases, the form which the satisfaction of the need takes actually defines the particular need. An individual is hungry — needs food — if food actually satisfies him. We do not assume, therefore, that an individual originally recognizes the nature of a particular determining need and *directly* proceeds to satisfy it. Possibility for satisfaction is inherent. It is biologically determined. The mode, however, is established by the nature of the object that brings him satisfaction. We can understand then how an adult may often have a need, but fail *at first* to recognize its nature. From his general restless activity may possibly come a way that brings satisfaction to him. His intra-organically determined restlessness then disappears. Figure 7 shows the change in behavior of rats following a change in their food.

Regarding instincts, Koffka has pointed out that the various powerful forces that produce instinctive activities are not to be found so much in the stimulus-situation as within the organism itself. The several needs of the organism, he claims, are the major causes of its action; and when these needs have been adequately satisfied, action comes to an end. We must recognize that because of these general biologically determined conditions of hunger,

thirst, sex, discomfort — which we consider as being instinctive — man has actually produced a great many things which serve to satisfy him in various ways. Some of these products are purely physical in character. Of these we can mention only such things as tools, literature, houses, liquor, clothing, beds, tobacco,

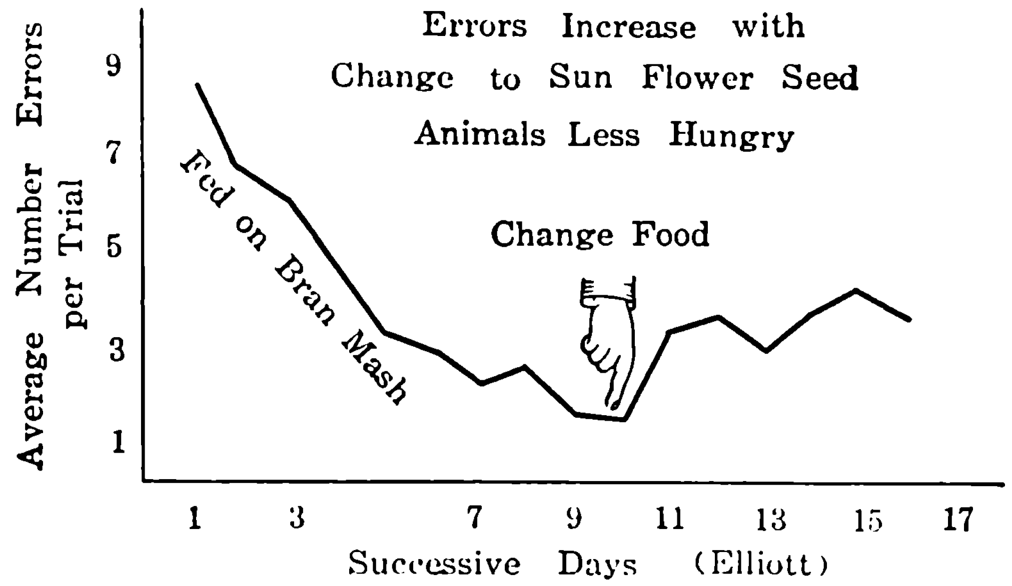

FIG. 7. Animal behavior shifts under a change in food.

machines, money, roads, drugs, vehicles, and weapons. Others, however, are purely psychological. Here we can indicate only a few, *namely*, rules, customs, ceremonials, taboos, slavery, marriage, and prostitution.[1]

B. *Some Non-Instinctive Forms of Behavior Which Have an Inherent Basis*

a. Play. The above factors indicate the *kind* of determining agencies which we shall regard as being instinctive. But there are other forms of activities for which a biological or hereditary basis also exists. As we shall try to make clear, we hold that there are many forms of activities which are in part inherently determined but which cannot rightfully be regarded as being instinctive. That is to say, we do not find a play need that possesses the characteristics of sex, hunger, or thirst needs. It does not, for

[1] The understanding student will realize that such instincts as we have accepted here are also characteristic of the animal. In these respects man and animal are alike. Thus, man's superiority over animal cannot be written in terms of the amount of hunger he can show or the amount of food he requires in order to satisfy his hunger. The same may be said of the other determiners. Because man must unquestionably be credited with the possession of certain subhuman characteristics does not justify one in assuming that man has no *other* characteristics. The differences between man and animal are much greater and more striking than are the similarities. A very superficial consideration of what man has done, in part, because of his hunger as compared with similar accomplishments of the animal should clarify the differences.

instance, persist as do the latter; nor is it so insistent. Moreover, a given period of play may be greatly extended without diminishing whatsoever the urge or desire to play.

To make this point clear, let us glance briefly at some aspects of play. As a result of the very nature of his nervous constitution, man shows playful behavior. There are no patterns for playful behavior laid down in the nervous system of a human being. There are no organs or structures, moreover, which might possibly serve as the basis of such activity.[1] Yet man very early shows playful behavior patterns which he evidently does not learn. As a young baby, he is bodily active because his nervous system is composed of highly unstable chemical materials which constantly release energy into his muscles. This infantile behavior, which we regard as being playful, is very simple in every respect. The individual is so lacking in muscular strength and his later coördinated patterns are as yet so undeveloped that his total repertory of actions is somewhat limited. Yet a surprisingly large number of unlike movements appears. This neural instability which early results in the production of many actions must be regarded as furnishing the bodily or physiological basis (source) of a great variety of activities to be found throughout the life of an individual. Although we assume that the various activities which are involved in play are quite dependent upon inherent characteristics of the living organism, we do not feel justified, however, in accepting some form of instinctive determination for them.[2] To understand this position let us agree, first of all, that from *no* point of view has every form of hereditarily determined activity or ability of human beings been considered as being instinctive in origin.

1. *Play Is Innately but Not Instinctively Determined.* There are several significant activities of man which no sensible person has ever regarded in any way as being instinctive. Yet they definitely are, within limits, quite independent of learning;—for instance, one individual when compared with another cannot sensibly be regarded as being either more or less instinctively feebleminded at the moment of birth.[3] They do not, in any way, learn

[1] An isolated pup will chase its tail, roll around, toss, and chew objects. And a baby will play, i.e., move its arms and legs, rustle papers, pull and push at things, including members of its own body.

[2] If the student will compare play with hunger in terms of its satiation, persistence, etc., his understanding will be increased.

[3] We refer to hereditary determination through the germ-plasm.

over a period of years to be feeble-minded. Superior individuals, moreover, are presumably superior in intelligence from the very *beginning* of their lives. They do not learn to be superior. No one has ever succeeded in teaching individuals to become inferior, normal, or superior in intelligence. If teaching and good environment were actually effective along these lines, the program of improving human stocks through legal sterilization and segregation of the feeble-minded, as well as eugenics and breeding, would have little positive value. Various persons have repeatedly attempted to make children of subnormal mentality behave in a normal manner. But from the time of Seguin, who worked along these lines with a totally deficient boy, to the present time all attempts of this sort have been wholly fruitless. Other illustrations of this same point occur in connection with special abilities and aptitudes, particularly as they appear in the genius. There are, then, various types of psychological activities of man, in addition to those of play, which appear to be largely determined through his heredity. Yet in no case can an instinctive basis or expression be discovered.

We assume that an infant plays because it is a dynamic living organism in which bodily activity *spontaneously* appears largely as a resultant of the unstable constitution of its nervous system.[1] Because an individual is at first psychologically undeveloped, his play is necessarily quite simple. As he grows older, he gradually develops greater control over his actions, he enlarges his imagination, and he increases his understanding. At the same time, he gradually broadens and diversifies his play world both by dropping some of his old play objects and behavior patterns, and by includ-

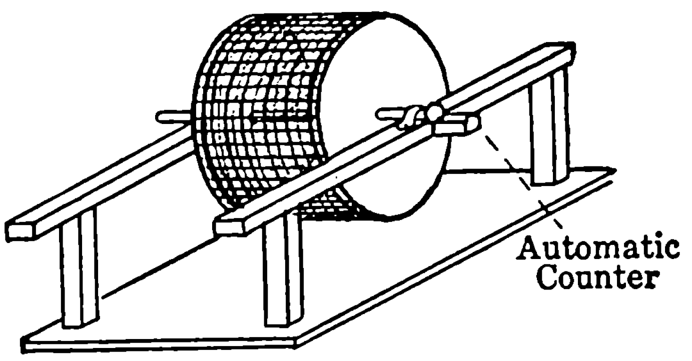

FIG. 8. A white rat may run twenty-five miles in one day.

[1] Spontaneous activity appears in all animals; that is, animals move although unstimulated in any known manner. The work of Slonaker and of Richter indicates that rats may run fairly great distances during the course of a day as measured by apparatus similar to that shown in Fig. 8. While the average may be around five miles, some may run as much as twenty-five miles. Such activity may be related to sex, but the relationship has not been established. The removal of the uterus or the seminal organs has no discoverable effect upon such activity. Castration, in some unknown manner, results in a drop in general bodily activity. According to Ligon, rats are more active at a six-hour period after eating than they are at a twelve-hour period. Then activity increases rapidly after the latter period.

ing new objects and new patterns. When he is psychologically equipped, through such functional abilities as action, understanding, and imagination to abide properly by the rules and the regulations of organized games, the child may enter a group and play coöperatively with other individuals. And until he has developed such traits, instinct or no instinct, he remains outside a play group. The *adult* human being plays as a result of several unlike conditions. The simplest is that within certain limits he secures pleasure directly from being active — from doing something.

2. *Play as a Way of Escape.* At times, an individual appears to play in order to escape the various restraints imposed by his social group upon some of his activities. In play, he may be afforded an opportunity to do many things which are expressly forbidden in non-playful situations. He apparently derives a considerable degree of pleasure from such social circumlocutions. In play, again, he may seek relief from the strife and the strain of his industrial and professional life. When his world of work bears too heavily upon his peace, his happiness, or his efficiency, he may escape temporarily into his world of play. Here he can momentarily relax and forget; he can hop, skip, and jump without a censorious eyebrow being lifted. He can again express for a time his more youthful patterns and enjoy their attendant freedom from adult cares and their delightful feelings of irresponsibility. Thus maturity may recapture its youth. In other forms of play, especially those which involve skill, an appeal is often made either to the imagination or to the competitive interests of an individual. Where no economic stake is involved, competitive play in its manifold forms appears most often to be based upon some desire either to excel others or to escape from boredom and inactivity. In such cases, both the winner or the loser usually become disinterested if the outcome is always determined in advance. Not for very long will the average individual directly derive pleasure from playing a game at which he is always beaten. Only love, ambition, or sheer desperation will seemingly hold a man to such forms of play.

Play apparently touches a great many phases of man's life from its very beginning to its end. Its universality among human beings of all ages and of all races is fairly good evidence of its importance. While an individual may possibly be said to play at times for the sake of his health, the happiness of another, or the enhancement of his business and professional opportunities, we

commonly regard play as being a direct *end* in itself. This is strikingly true of subhuman, infantile, and adolescent forms of play. It is also true in all these cases in which individuals escape for a time from social pressure. Because playful activity offers him an end in itself, it normally possesses great therapeutic value for man. Often nothing can possibly be more helpful than play in bringing relief to a tired individual. Generally speaking, the individual who is momentarily able in play to submerge his personal interests and problems undoubtedly possesses sound insurance against neurotic attacks and boredom. If a man is unable to play he must necessarily find his moments of diversion in work, or in religion, or in drink. While some may stand up unfalteringly under constant and exacting work, many individuals apparently break down. Work is not man's sole approach to happiness and psychological integrity.

In our opinion, every normal individual should be properly encouraged during his earlier and formative years to develop several sensible forms of play of such a nature that they may be easily and safely carried over into his more mature years. Intelligent guidance of youth in this manner would, no doubt, materially assist at times many harassed individuals in meeting various troublesome periods of their later lives. The man with a good hobby — a form of play — is strongly fortified against adversity. To the degree to which the various art, craft, and recreational departments of our public schools succeed in establishing fairly permanent patterns of creative play in our youth, they must be commended. As a nation, America has apparently lagged far behind many European countries in lending official sanction to organized forms of play. Seldom, indeed, in this country have many thousands of young people gathered to execute mass plays. Such spectacles, however, are not uncommon in Europe.

b. Collecting and Ownership. Man, as a child, picks up everything that he can perceive, get his hands upon, or put into his mouth. He has, at first, neither pockets nor understanding. For him, as an infant, there is no ownership or possession of property. The chance objects which he picks up from moment to moment are either eaten or dropped. As his age increases, his motives change: The old ones disappear and new ones are added. A sufficient degree of understanding necessary for ownership is gradually developed. And, at this period in his life, we usually find an

individual beginning to collect or retain objects. Although the motives for such behavior may possibly be partly *utilitarian*, they usually appear to be largely *appreciative*. Individuals collect because they are interested in objects, because they like to possess them ("it is fun," they say), because they derive pleasure out of handling them, and because they "get fun" from trading or exchanging them. Normally, we find that bright, clean, smooth objects of any given class are unquestionably preferred even by young children to dull, dirty, rough objects. There are actually so few of the former, and so many of the latter sort.

With increased psychological development, an individual's concept of property many be greatly expanded through perception, through imagination, and through thinking to include many environmental objects of very diverse characteristics. Probably every normal person, during shorter or longer periods of his life, collects many things. The objects collected vary so greatly both at the *same* time and upon subsequent times that there is little relation between (1) their nature or the general character of the environment and (2) the particular psychological characteristics of the collecting individual. The *degree* to which the collection of particular objects may extend seems to be determined by the nature and the amount of collectable objects in a particular environment, by the extent to which companions and associates collect, by the momentary interests, and by the strength of desire or need for pretty, or unusual, or purely useful things. Such facts give us a better understanding of the actual causal nature of collecting activities.

The Nature of Things Collected. Man normally does not collect any kind of object of which there is a constant, unlimited amount unless he has some very precise purpose in view such as preserving unlike forms in a museum against the time of their possible extinction. The accompanying table (after Bühler) reveals the *percentage* of things collected by boys and girls at two different ages (12–13 (A) and 14–15 (B)). The *law of supply* appears to rule here as it does in so many other cases. Where the supply is apparently unlimited (food, water, clothing, fuel), man shows no more "instinct" for collecting than the various animals we have previously mentioned possibly do for fear. Tropical man, for instance, does not face long periods of natural deprivation of food sources — he is not subjected to climatic cycles. He sel-

dom works. On the contrary he lives, it seems, from day to day. Nature is easy with him, and so are his life and his morals. Here, where environmental conditions are quite lavish in their varied offerings, man may not even trouble to collect a permanent wife for himself.

TABLE II

	A		B	
	Boys	Girls	Boys	Girls
Silver paper	5	7	0	8
Stamps . . .	35	5	31	0
Badges, book signs	20	6	0	16
Picture post cards	2	10	18	27
Books, magazines, programs	8	9	31	8

c. **Work.** Tropical man's obvious reluctance to work raises an interesting question. Must we assume, contrary to what we are often told, that an instinct for work is really lacking in man — that nature seemingly has not intended that man should earn his bread by the sweat of his brow? Is the sluggard of the tropics and the polar regions more natural than the tireless worker of the more temperate climate? Generally speaking, most primitive peoples who live under conditions such that most basic needs are easily satisfied do not appear to be very industrious. At a less primitive level, however, man is more industrious. Civilized man often continues to work long after he has satisfied the basic needs that apparently motivate the work of primitive man. Of those individuals among us who work untiringly and persistently, many maintain that the love of work for its own sake is truly instinctive in the race.[1]

The normal man, if we may believe such individuals, should think of his work by day and dream of it by night. He should work hard and like it greatly. As a matter of fact, however, the indefatigable worker sometimes impresses the critical observer as being perhaps somewhat unusual in his motivation. Such ceaseless activity may be regarded as being a symptom of some psychological trouble. It may possibly be interpreted as an attempt

[1] The student is referred to an interesting book by Veblen, *The Instinct of Workmanship.*

to escape from some unpleasant situation or condition. Through hard work, men apparently find at times a certain measure of relief from their troubles. Again, it may be that some men cannot stop their work and remain happy. They are unable to do anything else; they have no substitute outlet for their energies. Henry Ford, for example, has maintained that a man ought to work as long as he wants to, and he ought to enjoy his work so much that he wants to work as long as he can. He also points out that thinking men know that work is the true salvation of the race regarded from moral, physical, and social angle.

d. Other Forms. We assume, then, that such diverse activities as play, collecting, ownership, and work arise out of the nature of the various relations established between man and the objects of his environment because of his chemically unstable nervous system and his personal history. They are not instinctive in origin. We hold, moreover, to the position that the very common motives which underlie jealousy,[1] rivalry, and fighting arise solely from an individual's realization of the *existence of inequalities* in his world — from his recognized lack of unlimited opportunities to meet or to satisfy his needs for many things such as food, water, comfort, and sex. One individual possesses what another lacks but would like to have because it has the power to satisfy him. That thing which he would like to have may take the form either of some human or non-human *object* or of some human *trait* or characteristic. Out of his direct recognition of this inequality among different individuals in terms of the possession of sources of satisfaction comes a variety of actions. Men apparently fight because of that which they do not have, but would like to possess; or, they fight to retain that which they now possess because it has previously given them satisfaction.

When a thing ceases utterly to satisfy an individual, it is usually cast aside, in the words of the adage, like "an old shoe." Men not infrequently abandon, with a degree of apparent indifference and

[1] Of life at a simple level, Mead writes: "Friendships are of so casual and shiftless a nature that they give rise to neither jealousy nor conflict. Love and hate, jealousy and revenge, sorrow and bereavement, are all matters of weeks. From the very first months of its life, when a child is handed carelessly from one woman's hands to another's, the lesson is learned of not caring for one person greatly, not setting high hopes on any one relationship. The Samoan girl never tastes the rewards of romantic love as we know it, nor does she suffer as an old maid who has appealed to no lover or found no lover appealing to her."

ruthlessness somewhat appalling to their fellows, the many things — wives, friends, children, ideals, standards, beliefs — which they have apparently outgrown. It may very well be that the desire to possess one thing is so strong in them that all others are momentarily submerged. Some men, at times, will apparently relinquish quite freely what other men cling to tightly. The thrifty individual may view with mild horror the lavish spending of a drunken sailor.

OUTLINE

CHAPTER III. PHYSIOLOGICAL AND PSYCHOLOGICAL DETERMINATION OF ACTIVITIES

III. Physiological Determination
- A. Innate vs. Acquired Needs — Drug Addicts
  - a. The Basis of Restlessness
    - 1. The Rôle of Pain and Discomfort
  - b. Curative Procedure
    - 1. The Place of Memory and Imagination
- B. An Orientation
  - a. Types of Motives
    - 1. Instinctive
    - 2. Habituated
    - 3. Ideational

IV. Psychological Determination
- A. Effects of Social Restrictions on Human Behavior
  - a. Use of Alcohol
  - b. Psychological Escape Mechanisms
- B. Significance of Individual's Past
  - a. Freud's Position
  - b. Two Illustrations
- C. Significance of Childhood
  - a. Reasons for Importance
  - b. Need for Wise Treatment
  - c. Only Child
- D. Forgetting and Repression
  - a. Causes
  - b. Repression among Savages
  - c. Is Repression Necessary to Civilized Living?
- E. Rationalization
  - a. In the Normal Individual
  - b. In the Abnormal Individual
- F. Inferiority and Compensation
  - a. Recognition of Inequalities
  - b. Inferiority and Bullying
  - c. Sexual Bullies
- G. The Rôle of Goals
  - a. Nature
  - b. Significance

V. A Final Word

CHAPTER III

PHYSIOLOGICAL AND PSYCHOLOGICAL DETERMINATION OF ACTIVITIES

III. Physiological Determination

In addition to the various types of biological determination of activities directly established through heredity, there are other forms of determination which apparently arise almost wholly through the personal history of an individual, and for which, strictly speaking, neither a hereditary nor a biological basis has been discovered. Of the two very general divisions of such factors, namely, the physiological and the psychological, we wish first to consider the former. We shall indirectly refer, in this discussion of physiological determination, to several very general conditions which are assumed to give rise to those unlike motives, of varying degrees of intensity or strength, which partly determine some of man's habituated needs and their resulting activities. For these motives no precise *bodily basis* has ever been established. It is quite impossible to give an intelligible description, for example, of the physiological mechanism involved in such needs and wants as are induced through smoking, drinking (alcohol or coffee), and taking drugs. But not infrequently these motives, which are often stronger, when measured in terms of their insistence, than some of those we have previously mentioned, may be created in an individual in an astonishingly short time. Moreover the possible harmful consequences, not only to the individual, through a loss of his health, his happiness, and his efficiency, but also to society through a resultant increase in both delinquency and crime,[1] stand as a source of evidence and as a constant reminder of the distance to which some of these acquired motives may actually carry a particular individual.

[1] The student should realize that in addition to the complete indifference to the suffering of others which finally appears in the drug addict, the cost of the drug is a major contributory factor to criminal behavior. When the cost of consumption of drug increases, as it may, to as much as ten dollars per day (and the individual's efficiency decreases to zero), robbery (and murder) are almost certain to follow.

A. *Innate vs. Acquired Needs — Drug Addicts*

Generally speaking, these acquired motives apparently express themselves in the behavior of an individual in much the same manner that the hereditarily established types, such as hunger and sexual appetite, do. The constant drinker, the inveterate smoker, or the chronic drug addict, upon being denied an opportunity to satisfy himself in his usual manner, shows a very striking degree of restlessness. Whereas hunger or sexual desire may either temporarily decline or be momentarily submerged by other needs or desires, the need for tobacco, alcohol, or a drug steadily mounts as the period of satisfaction is delayed. This manifest difference between innate and acquired needs in terms of their relative strength or insistence under denial is rather illuminating. It points the way toward a larger understanding and a fuller appreciation of the general significance of individually acquired behavior patterns. The continued use of a drug over a period as short as a few months may so strongly motivate an individual that, when suddenly denied adequate satisfaction, either murder or insanity may possibly result. It is true that man may become insane when denied food, but considerable time may be required. With a drug, however, it may take only a few days. The exact nature of the physiological mechanism involved in these acquired needs, as we have said, is quite unknown. No scientific description of possible tissue changes in the body to account for these intensely experienced needs has ever been written. The fact remains, nevertheless, that a human being can be so functionally disposed, in a surprisingly short time, that the subsequent nature and course of his whole life may be greatly changed. Here is evidence, then, of a significant truth: The acquired may be stronger and more significant than the innate.

a. The Basis of Restlessness. The extreme restlessness of an addict who is denied his usual form of satisfaction arises in part from the very great discomfort of pain. The gnawing pain of unsatisfied want appears in a few hours following the last dose, and very rapidly increases in intensity. The individual becomes racked with pain. And with this pain there goes a longing, a need, or a desire for relief that is wholly unique. It is more than mere pain; and it is more than hunger or thirst. It is an actual reaching out or a dynamic thrust of the total organism toward particular

objects of its environment in its endeavor to secure adequate satisfaction. In this quest the whole organism is very definitely activated. An individual lacking satisfaction is usually unable to eat, or sleep, or work, or play. Even the chronic smoker when deprived of his tobacco may show, for some little time, a considerable degree of instability toward some of his environmental objects, as well as nervousness, nausea, dizziness, insomnia, and distractibility. The alcoholic or drug addict usually shows all these disturbances to a much greater degree and over a much longer time.

b. Curative Procedure. To be relieved permanently of the latter types of needs or wants, men are usually compelled to seek outside aid and guidance. The many therapeutic institutions to be found over the country with their locks, bars, and highly trained physicians attest silently to the strength of these acquired motives. Many men when confined in these institutions must be closely watched and their dosage carefully regulated in gradually decreasing amounts in order to avoid the possible development either of a permanently impaired organic condition or of insanity. The need may be so great that the individual who has become strongly addicted is often unable to stand up under the terrific strain of denial. The "cure" in many cases may actually kill. Recently a well-known writer died in an institution to which he had gone for the purpose of securing some measure of relief. Shortly before that time, a motion-picture actress was legally restrained for her own good, but died a bit later from the effects of the drug which she had been using.

The motive in such habituation apparently involves all activities of the whole organism. Each psychological function is usually concerned. The individual perceives here and there; he remembers the old periods of satisfaction and imagines new possibilities; he dreams of complete and lasting satisfaction;[1] he thinks about and plans many ways of securing relief, even, perhaps, while he is confined in an institution; and all the while he is emotionally disturbed. There is obviously a strong psychological aspect associated with the individual's final release from these needs. For instance, in the usual treatment of a drug addict, the dosage is gradually

[1] The reports of men long habituated to the use of tobacco, who have been shipwrecked or lost in the polar regions, are illuminating. Again and again, they dream of mountains or shiploads of tobacco into which they throw themselves headlong to seize great handfuls.

reduced in *strength:* and, at the same time, the individual is constantly encouraged to fortify himself against his need. Toward the end of the curative period, the physician begins to give the individual a dosage which the latter believes to be the drug, but which the former knows to be medicinally worthless powder.

Moreover, a major reason for the failure of so many individuals to be completely relieved of some of these more insistent types of needs is unquestionably psychological. The individual's memory and imagination actually betray him. When his life conditions become very difficult and the way ahead of him is not very clear, the former addict may picture in his memory or in his imagination the delightful freedom that was or is to be found in that semi-dream state — which, once entered, has actually neither time nor place properties. All too often, we know, this region does not beckon in vain. That is to say, there are many institutional recommitments in addition to those who have ceased to care.

B. *An Orientation*

So far we have considered (I) those several motives of an instinctive type which directly arise from the hereditary foundations of the human organism. We have listed these under the several heads of hunger, thirst, sexual appetite, and bodily discomfort. We have been forced, however, to reject others such as play, collecting, ownership, jealousy, and rivalry as being fundamental forms of instinctively determined needs. We have sought to recognize the significance of all these various determining factors for life activities. We have frankly confessed our inability to approach human beings understandingly without granting instincts a proper place in our thinking. We have suggested that to deny their significance is equivalent to rejecting the obvious. It would appear that only those individuals who love theories and dislike facts, or who delight in giving new names to old concepts are inclined to ignore instincts.

But to accept one form of explanation does not necessarily restrict an individual to a single type of explanation. Man is not always pushed along solely by sheer biological necessity, or by the dead hand of the race. He is not always an animal, seeking to satisfy purely animal needs. Hunger, thirst, sexual appetite, and discomfort surely motivate him. But he also shows (II) acquired desires, *in a way that no subhuman ever does*, which may, as we

have said, actually be much stronger as an immediate determiner of his behavior than some of the innately determined sort. Furthermore, in addition to these habituated desires which involve the human organism in some unknown physiological manner, there are (III) motives or desires which arise directly because man creates goals and objectives toward the final attainment, realization, or maintenance of which he may continually struggle during his whole life. These established meaningful characteristics of situations, which may also be called ideals and standards, exist because man possesses sufficient imagination to enable him to envisage the possibilities of securing satisfaction at a more or less remote time. We wish now to discuss the rôle that such goals play in determining man's psychological activities. The understanding student will surely realize that in these effective goals is to be found a very significant causal factor which is produced *through* man's psychological abilities and which in turn serves to determine and color the subsequent course of his life. Thus one form of psychological function together with its products may be directly referred to in explaining something that an individual does, in very much the same way that one chemical change may be used to explain another chemical change.

IV Psychological Determination

Man is not an enlarged edition of an animal. He is quite unique in that he possesses many emergent characteristics which are wholly different from those found among subhuman organisms. Judged in terms of his achievements, man's psychological life runs at a level higher than that of his nearest animal relative, the anthropoid ape. The significant differences between these two levels of life are essentially *functional* in character, that is, the dissimilarities must be put in terms of performance and not structure. Through the use of his imagination and his thinking, man has been enabled to envisage the possibility of a world of such nature as to contribute materially to his independence, happiness, peace, and contentment. He has definitely sought to shape his world in such a way as to make it fit his ends and his purposes. That he does not always succeed is not necessarily his fault. "Man sets forth upon life," Stevenson has remarked, "with high and difficult ambitions; he means to be nobly good and happy; and it is

because he fails in his celestial enterprise that you may behold him rolling in garbage."

A. *Effects of Social Restrictions on Human Behavior*

Forms of Escape. Society constantly hedges man on every side with various restrictions and taboos. Although an individual may know full-well the particular direction in which he may wish to go in order to secure greater satisfaction, he may be prevented or thwarted by some social barrier. The several social as well as economic limitations imposed upon his various attempts to find adequate satisfaction for his more persistent needs not infrequently contribute to his distress and his unhappiness. Because of these conditions, life, even at its very best, may fail to produce the degree of peace and contentment that an individual may possibly expect. Consequently, recourse to some temporary mode of escape may be the only way possible for many individuals to secure relief. The universal employment by man of alcohol and drugs is good evidence of his inability to sustain himself permanently without extra-organic aid in a narrowly and undesirably limited environment or situation.

At times, individuals may find satisfactory forms of escape through the excessive use of their imagination in play or in day-dreams. "The clergyman, in his spare hours, may be winning battles, the farmer sailing ships, the broker reaping triumphs in the arts; all leading another life, plying another trade from that they chose. There are men who do not live by bread alone, but by some cherished pleasure; who are meat salesmen to the external eye, and possibly to themselves are Shakespeares, Napoleons, or Beethovens; who have not one virtue to rub against another in the field of active life, and yet perhaps, in the life of dreams, sit with saints" (25).

At other times, individuals seemingly escape by developing some form of illness, or social or biological inadequacy. Thus, in some forms of hysteria, individuals may become functionally deaf, or paralyzed. Some may be quite helpless, although they may suffer no pain or discomfort. As a result, they undoubtedly escape many painful phases of life. They may be waited on or assisted by others. They may also be the objects of regard and the recipients of much sympathy. They may not be able to work, yet be very insistent upon receiving due recognition from others.

Suicide may possibly appear to some persons as being the only way of removing all barriers to the attainment of an end.

B. *Significance of Individual's Past*

Freud's Contribution. No other individual has created as much interest in the various problems of psychological motivation as has Freud. He must be regarded as being among the very first to try seriously to discover the motivational foundations of man's psychological activities. More than any other, he has pointed the way that seemingly leads to a fuller understanding of the determining factors which lie back of the various activities of man as these are concerned with his dreams, forgetting, mistakes, jokes, longings, fears, prejudices, and nervousness, as well as his more serious abnormalities. From his hands, and the hands of his students, have come tools and devices which have often served, when intelligently applied, to release men from the too oppressive bondage of their past — to give them, in short, some degree of relief from their psychological troubles. These troubles arise out of their past. While they are the source of considerable pleasure, man's memories are also the cause of much of his distress. Freud has sought to show that his many troubles need not necessarily be permitted to continue to afflict an individual. They may be discovered and removed if the proper procedure is intelligently followed.

Freud's contributions have tended to show clearly the significance to be attached to the personal history of an individual as a major determining factor of his life activities. He was the first to lay such strong emphasis upon the value of the historical approach as a fruitful way of securing a larger comprehension of some abnormal phases of human behavior. He has continually insisted that an adequate understanding of the causes of many psychological events, including both normal and abnormal kinds, can be secured only through a knowledge of earlier contributory experiences. He has wisely stressed the importance of psychology as a way of understanding life. In opposition to him have stood many persons who have tended to think in terms of non-psychological forms of explanation. Their emphasis has mainly been such factors as (1) the physical stimulus as an exciting agent, (2) the sense organs, which are affected by the stimulus, (3) the muscles and glands, and (4) the brain which controls the latter. Of the two ways, we must say, Freud's in several respects has cer-

tainly been more illuminating although perhaps less experimentally scientific than the other. Inasmuch as we assume that man's psychological life normally runs as far as an understanding and a description of it are possible, at a meaningful level quite above that of sense-organ, brain, and muscle; and since we also assume that that which precedes some event must in general have significance for that which follows, we find some of the general principles laid down by Freud and his students to be singularly illuminating. Freud recognizes that an individual may have no knowledge of the contributory conditions of his thoughts, feelings, and actions. Although the individual himself may have no remembrance of any particular event or experience which might unduly have affected him, Freud maintains that some condition in his past serves to determine in part the various forms of his behavior. He calls these unconscious memories.

We wish to give some simple illustrations to show how the past of a normal individual may partly determine certain psychological activities without his having any knowledge whatsoever about its operation. Everyone will grant the constant use made of thousands of such ordinary words as "am," "is," "was," and "were," which are combined and recombined in many patterns to express varying shades of meaning. Yet a normal individual may have absolutely no memory either of the time or of the nature of the occasion when he acquired many of these terms and phrases of his language. To make our point quite clear, we can actually say that as far as an individual's own personal memories are concerned his use of his language is wholly innate; and that as far as he knows *he began to talk at the very moment of his birth.* The following story may possibly assist the student's understanding. Recently, I started to tell a good joke to a friend whom I had not seen for some little time. I had scarcely begun when I saw a peculiar expression on his face. Having finished, I asked him the reasons for the expression. With considerable amusement, he pointed out that he had told me that same story about one year ago. I had wholly forgotten the occasion, but I had clearly remembered the story.

C. *Significance of Childhood — Only Child*

It is unquestionably true that each individual, as a child, must have had a great many experiences which by the time he reaches an adult age he has apparently forgotten ever having had. The

effects of these experiences, however, may possibly remain with the individual and not infrequently produce, during his adult years, very striking changes in his psychological functions. Many of man's likes, dislikes, fears, prejudices, attitudes, desires, and longings which often seem to be innately determined may thus be properly explained. The originally experienced situation which gave rise to them may be completely forgotten by the individual. But the determining influence upon his psychological activities persists.

Importance of Wise Treatment. The period of childhood possesses peculiar significance for Freudian students. The reasons for this, we suggest, lie partly in the immature organism's unusual degree of *susceptibility* to situational changes, and partly in its quite pronounced tendency to *forget* the particular occasions of its various experiences. We must recognize that during their earlier years, individuals do not remain functionally unchanged, although very few, indeed, can remember very many of the thousands of experiences which necessarily occurred during this period of their lives. The pre-school years, for instance, constitute an important period in an individual's life because the motivational basis for many subsequent activities is then established. During these early years an individual is definitely inclined in many ways toward the various phases of his world. Because of the nature of his childhood experiences he may later show, among many others, such traits as generosity or selfishness, kindliness or cruelty, coöperation or antagonism, shame or pride, sulking or good humor, contentment or dissatisfaction.

It is widely granted that the only possible solution for the majority of the undesirable fears, neurotic actions, unreasonable nervousness, and the excessive timidity of the adult years lies in the forgotten experiences of childhood days. An intelligent recognition of the wide possibilities of establishing during the early formative years of an individual's life many permanent dispositions for behavior may possibly mean, during the later years of his life, the difference between a well-balanced individual on the one hand and a neurotic adult on the other. A slight investment in human values at the post-infantile level may actually pay far more valuable dividends to an individual when he reaches maturity than any possible sum of money set aside to accumulate for him ever could. Ignorant neglect of a developing child may serve,

like improper physical punishment, permanently to twist or mar a personality.

The chances of his birth, too, may significantly affect the manner in which an adult meets and settles his life affairs. The only child, for instance, seems to arrive at clinics in somewhat disproportionately larger numbers than we should normally expect to find in terms of their total number in the general population. In these cases, various familial conditions have presumably contributed to the development of undesirable social attitudes and emotional patterns. Too much solicitude, pampering, regard, or affection may unduly incline a developing individual toward an egocentric point of view. In such cases, a subsequent failure in late childhood or in early adolescence to find similar treatment accorded him by non-familial associates may lead directly to the feelings of being unappreciated or of being slighted. From these in turn may issue sulking, obstinate, over-bearing, and over-sensitive patterns of behavior.

Frequently the only child is a product of divorced parents who were unable to maintain happy marital relations because of the presence in one or both of neurotic patterns and attitudes. Moreover, the consequences of divorce seem generally to rest more heavily upon the shoulders of the mother, into whose hands the only child is more often delivered. Under such circumstances, the child often tends to assume an exaggerated importance in the eyes of its parent. It may become the sole object of her devotion. Or the mother, busily seeking new marital ties, may possibly, through neglect, produce or exaggerate such attitudes as shyness, timidity, and unworthiness, which may linger on into the adult years. Again, the only child may form such strong ties with its maternal parent that, where the latter does not remarry, the establishment by it during the adult years of strong *non-parental* attachments is difficult if not impossible. This seems especially to be true of a son. Under these conditions, an individual may be quite unable to find happiness through marriage. Love and obedience by a son for a loving but possibly short-sighted parent may go far in this manner in determining the subsequent course of his life.

D. *Forgetting and Repression*

a. Causes and Effects. Many experiences of an individual from infancy through maturity are forgotten. Some forms of this forgetting may be "explained" purely in terms of chance. Much of

it, however, is not easily disposed of in this manner. Forgetting seems at times to serve as a mode of escape from unpleasant realities. When a man possesses some desire, wish, or attitude that is quite incompatible with those personal standards established in the past or with the general standards of his group, he may deliberately try to repress it.[1] If an experience has been very painful, very distressing, or very disturbing, an individual may actually forget it. These are, however, usually abnormal or border-line cases. A normal individual may forget or mispronounce the names of persons who tend to bore or irritate him. He may possibly forget to keep unpleasant appointments. According to Freud, man's repressions are more directly associated with his sexual desires. Being a major determining factor in life activities and being subjected to many restrictions and taboos, sex seemingly bears the brunt of repression. We suggest, however, that any strong desire or longing may possibly be repressed.

In cases where repression occurs, many activities of an individual may be both directly and indirectly affected. His feelings, actions, and thoughts may be deeply colored and disturbed. In extreme cases, it is quite possible that nervousness, distractibility, loss of memory, or actual paralysis may finally result. Many World War cases of shell-shock have been directly attributed to the effects of repression of a great fear aroused under fire and fighting. Such disturbances no doubt appeared in many cases in men who, because of their neurotic constitutions, were really psychologically unfitted, even before they entered military service, for the subsequent horror and strife of battle. The neurotic enlisted men tended, on the whole, to show one form of such troubles, while the officers, who labored under a dissimilar type of responsibility, appeared to show a related but different type.

b. Repression among Savages. From time to time it has been suggested that if so many of man's psychological troubles are to be causally referred to some form of sexual repression, life conditions in which such repression is relatively rare would not be so charged with disastrous possibilities. The interpretations which have been drawn from various observational studies conducted upon this general problem among primitive peoples, where sex is certainly

[1] Wister has written of Theodore Roosevelt, "The wistfulness blurred his eyes — that misty perplexity and pain which Sargent has caught so well. This look was a sign of frequent conflict between what he knew and his wish not to know it."

less burdened with the many taboos characteristic of the modern civilized group, seemingly point in that direction. There is a surprisingly small degree of sexual repression[1] to be found among many primitive groups; and there does appear to be a much greater degree of freedom from psychological troubles than we should normally expect to find. There is, however, a possible fallacy in such studies. In addition to sex, every phase of life among such peoples is probably much more simple than can be found at a less primitive level. The life of a primitive *adult* compared with that of a civilized adult is as the life of a civilized child is to that of a civilized adult. On the whole, the tropical native apparently plays at life.[2] It is quite possible, therefore, that such primitive adult simplicity tends to produce no more psychological abnormalities than does civilized childish simplicity. And it is well known that insanity rarely occurs among *civilized children.*

c. Is Repression Necessary to Civilized Life? These facts concerning life in simple societies are both interesting and instructive. But it would seem, nevertheless, that the large majority of individuals at the present level of our civilization must continue to be afflicted by repressions, if such be the case, for some little time. Certainly, no completely adequate solution for civilized man's pre-marital sex problems has ever been advanced. Companionate marriage, among other ways, has been suggested as a possibly happy solution. But as long as it shall be based primarily upon the evident desire of individuals to secure certain prerogatives without assuming, at the same time, certain responsibilities of marriage, it seems most likely to meet with little official sanction. Society at the present definitely tends to frown upon "playing at being married."

It may be quite true that civilized man has definitely evolved, psychologically speaking, beyond the stage of biological or subhuman promiscuity. The price which he must apparently pay, from time to time, in the form of his various psychological troubles,

[1] The girl's chances to live her life quite freely together with her intimate knowledge of sex and her lack of strong sex preferences reduce the possibilities of conflict. In Samoa, sex "is a natural, pleasurable thing; the freedom with which it may be indulged in is limited by just one consideration, social status." In these terms, Mead describes some phases of a girl's life in Samoa (19, *161*).

[2] The condition in Samoa which makes life easy is the casualness of society. It is a place where no one plays for high stakes, or pays a heavy price. No one suffers greatly for his convictions or fights to the death for special ends. No one is pushed rapidly along nor punished harshly for slowness (Mead).

though seemingly high to many individuals, may not after all be too exorbitant. It is indeed regrettable that civilized man can never fully know the actual price of such sexual freedom as is enjoyed by primitive human groups until he (society) has experimented or tried it out on a large and extended scale. Under our present social organization, the possibility of such experimentation seems to be quite remote. We must recognize, however, that today in the U.S.S.R. very great sex freedom is apparently permitted. Legally speaking, there seem to be no sex differences or barriers. If marriage is more preferred, a signature in the register is required. If a divorce is desired, another signature has merely to be entered in the register. A post-card announcement to the other party may be the sole cost and the first intimation of a divorce. No premium is thereby placed in any way upon marriage and no disgrace is attached to divorce. Illegitimacy is socially impossible, yet the free, state-supported abortion clinics apparently find it necessary to maintain full staffs. Great social changes may thus come suddenly. In New York City, for instance, the number of post-abortion cases admitted to hospitals rose from 2,313 in 1930 to 5,197 in 1933. It has been estimated that one-quarter million cases of abortion occur annually in New York City of which 80 per cent are married women. Fig. 9 shows the relative divorce rates in various countries per one million population. Such differences are both striking and significant. Only time can finally determine the nature of the various biological and psychological values which must necessarily issue from these new, emerging patterns of sex relations.[1]

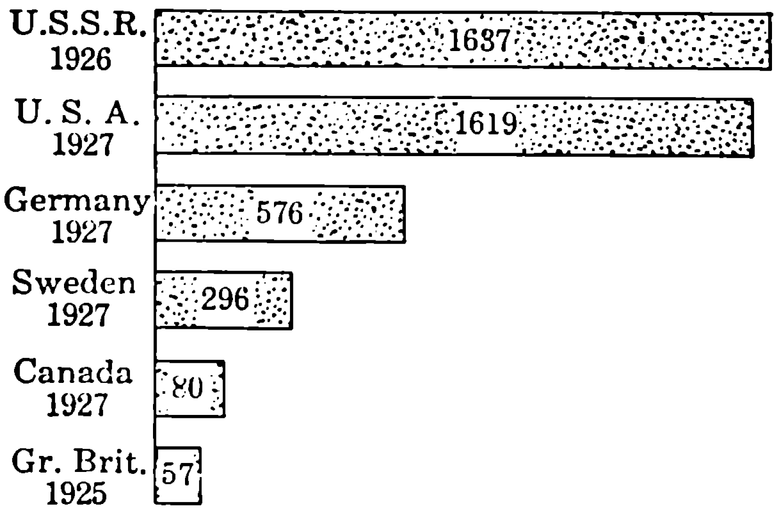

Fig. 9. Compare Russia, United States, and Great Britain.

E. *Rationalization*

Because an individual may forget various previous experiences, he frequently possesses little understanding of why he subsequently

[1] General promiscuity, according to some students, eventuates in racial deterioration. Certainly it is true that very different attitudes must prevail in those individuals who are promiscuous from those found in the individuals who have selective standards of sexual relations.

feels, acts, or thinks as he does about certain objects and situations. Of his behavior he may be quite sure, but of his motives for action he may be very uncertain. His peace and contentment usually demand, however, that he satisfy his desire for an understanding of the reasons for his behavior in a particular occasion. But such explanations are frequently discovered to be wrong. The unskilled but somewhat ambitious artisan, for instance, may actually be so oblivious to his own technical shortcomings that he may continually blame his tools, his materials, or other extra-organic conditions for the poor quality of his workmanship.

Moreover, the individual who may show an unreasonable outburst of anger at another over some trivial matter may possibly discover several explanations for his behavior. The basic reason, however, may be that the latter is really hindering, or thwarting the former in his search for satisfaction. Here a rough analogy may be drawn from the subhuman level. A man may approach the young of an animal, for example a bear, when the mother is present, as long as he does not get between the mother and her young. But when her view of her cub is partially or wholly blocked, the mother animal is quite likely to attack. This is also strikingly true of a male animal when a female is perceived. Under these conditions, it may be very dangerous for a man to block the way of the male to the female. This is a major source of difficulty in working with both sexes, as Beatty points out, in the same enclosure.

a. In the Normal Individual. The normal individual is frequently able to search rather critically among the several contributory conditions underlying his attitudes or actions and to come to a fairly sensible evaluation of them. He may discover that his actions toward a certain individual or in a particular situation must necessarily be regarded as being foolish because the discoverable reasons could not sensibly justify them. He concludes, therefore, that for some cause of which he is not quite sure, certain values have been greatly exaggerated; and that consequently a person or a situation has not been treated fairly. He is often able to realize that his behavior was largely a matter of emotional tuning and not of intelligent determination. He may accordingly decide to place his future dealings upon the latter level. And, if the basic motivational conditions are not too insistent, he will most likely succeed in his attempt.

In a great many cases of common likes, dislikes, attitudes, and desires, it seems a bit absurd for an individual to grope around among the various determining factors of his behavior in a search for adequate reasons or rational grounds. For the health and contentment of the average individual, this sort of analytical scrutiny should neither be practiced nor encouraged; it is an easy way to a neurotic state. Where some existing psychological condition, however, so determines his behavior as to interfere seriously with the happiness and the efficiency of an individual, therapeutical measures involving analysis are demanded. As long as there is no necessity, there should be no analysis. Unnecessary probing is as much to be condemned here as it is on the surgical table. We specifically make this point because we assume, without question, that normal individuals can produce striking changes in themselves by continued employment of some method, either good or bad.

b. In the Abnormal Individual. Rationalization appears in its clearest forms in the abnormal personality. Under these conditions it may be utterly impossible for an individual to evaluate either his own activities or those of others. Any solicitude, kindliness, or regard shown by others toward him will most likely be immediately rationalized by the individual in the light of some strong psychological determining factor. Recently a millionaire inventor was ordered by the courts to be institutionalized because he claimed his relatives were trying to obtain control of his property. The institutions for the psychologically disturbed are filled with individuals who persistently maintain certain fixed attitudes and activities toward others in spite of everything which may be said or shown them. Such persons, of course, need intelligent therapeutic treatment.

There are, moreover, many individuals to be found outside such institutions who also need more adequate understanding and treatment. Persons who have peculiar fears or serious speech impediments; individuals who show unusually strong likes or dislikes for certain things; those who cry or faint very easily; and persons who are troubled in other psychological ways, — all these are often incapable of realizing their full measure of happiness and efficiency without outside assistance and understanding. The writer, for instance, recalls his astonishment at seeing big, husky individuals pitch out of the lines of men who formed in the training camps during the World War in order to receive hypodermic injections

and vaccine inoculation against typhoid and smallpox. At times, these men would actually be some little distance down the line from the physician in charge. The mere anticipation of the skin puncture, together with some strong motivating condition quite possibly unknown, served momentarily to incapacitate them. It is not at all surprising, therefore, that a man who would faint at the thought of a scratch of the needle on his arm should develop a neurotic condition at the thought and expectation of having a bayonet thrust into the pit of his stomach.

F. *Inferiority and Compensation*

A former student of Freud's has sought to show that a most outstanding determining factor of human affairs concerns the individual's recognition of his own degree of adequacy or inadequacy for meeting life activities. The individual who regards himself as being quite adequately equipped in some or all respects to meet life situations may be said to possess a superiority complex. On the other hand, the man who definitely feels himself to be unequal or incapable of coping adequately with a particular situation has an inferiority complex. In terms of these two extreme types of determining conditions, Adler has sought to place his descriptions of the basic foundations of life activities. These are not innate determining factors, although they may arise in some cases from hereditarily determined structures (too much or too little, too large or too small). They are motivational forces which issue largely from the character of the psychological development or the personal history of an individual; they apparently come out of the ways in which he has earlier faced life and solved his problems of securing satisfaction. They appear because man recognizes the existence of *inequalities* among human beings.

Among the conditions which contribute to a conviction of inferiority, we find (a) physical and psychological inequalities, (b) inequalities in man's histories, and (c) inequalities in degree of possession of objects (property, wealth, attractiveness). An individual may develop a strong attitude of inferiority (a) if he should be unusually small, very ugly,[1] quite weak, like (similar to)

[1] Recently the face of a girl who was so ugly that she was unable to secure satisfactory employment was operated upon by a physician, who said, "Her face was so unfortunate that I could see how people would be prejudiced" (*Herald and Examiner*, March, 1934).

the opposite sex, deformed, unable to speak clearly, not very intelligent, or not very emotional in a sexual manner. Moreover, a strong inferiority feeling may presumably develop in an individual (b) if his family bears a bad name, if he has spent his years in the country or in a "hick" town, if there is some question concerning his birth status, if he has been repeatedly mistreated or pushed about from one place to another, or if (for some unknown reason) he is not accepted by his fellows. Finally, we know that strong convictions of inferiority (c) feed greedily upon poverty, poor clothing, disreputable homes, "living beyond the railroad tracks," empty lunch pails, or the lack of "pocket money." All these conditions may contribute directly to the development of many undesirable attitudes or activities.[1] Among others there are jealousy, cruelty, secretiveness, timidity, hesitation, undue sensitiveness, and lack of assurance. In the lives of such individuals, we may see various biological, psychological, economic, and social motives woven together, upon the strands of heredity, personal history, and environment, to determine their activities in many significant forms.

a. Reason for Bullying. With an individual's recognition of his inferiority or inequality there usually go compensatory efforts. The average person who has strong convictions of inferiority does not openly parade his inadequacies or his weaknesses; he seeks rather to cover up and to protect himself from an aggressive world by concealment and disguise. It is no doubt true that unusually profane, hypercritical, very obstinate, or strongly domineering patterns often serve to cloak deficiencies, inadequacies, and strong motives.[2] The hard swearer often seems to be trying to impress himself and others with his sophistication or with his dangerousness. Obstinacy in the normal adult, too, appears to result chiefly from his refusal to admit being wrong (weak), and not from a lack of knowledge or understanding. Moreover, the domineering individual of the bully type may be determined by his recognition

[1] They are undesirable because they interfere with happiness and satisfaction; because they do not permit an individual to be free from his longing to be equal to others.

[2] Of the campaign of Theodore Roosevelt in 1912, it has been said that he insisted with sincerity that he had no animosity against Taft; that he had no desire to return to public life; that he was forced by his followers to run for office in order to carry out the policies which he had started when he turned his office over to Taft. "Yet it is evident all through that he was bitterly jealous of Taft even from 1908 on and that the desire steadily grew 'to get back at the wheel'" (7).

of his intellectual deficiencies. An individual who is physically strong but psychologically weak may realize his inability to maintain his pace with others in more subtle ways. But he simply must secure some sort of satisfaction, else his life would be quite unbearable. He usually finds it in the only way possible for him, by picking on some person who is intellectually superior but physically inferior to him; or, lacking such an individual, on anyone of whom he is not afraid because he knows he can handle him.

b. Sexual Bullies. We wish in this connection to suggest a possible way of aiding the student's understanding of some extremely significant forms of human behavior. Occasionally, fully matured men may sexually molest little boys and girls. We may sensibly regard such men as being sexual bullies. Because of some earlier experience which has produced a very strong inferiority complex, they may be utterly afraid of women. They may actually be so timid that they can scarcely speak to one. They know, furthermore, the possible physical consequences to them should they approach a full-grown man. Yet the very persistent, unsatisfied, sexual desire remains. Such men frequently turn therefore to little children, of whom they are not physically afraid because, being *adults*, they feel superior to such individuals. In these several cases, the understanding student will easily see how very far along the road of delinquency and serious crime a purely psychological condition, such as a feeling of inferiority together with its compensatory expression, may possibly push unfortunate individuals. Thus, we have *one* explanation.

G. *The Rôle of Goals*

The ideals and goals which a man possesses serve constantly during most of his life to color and determine his psychological functions. These are a direct product of his personal history and his environment. Because of them, man orders his diverse activities in a way that is entirely peculiar to the human level. Only man has ideals. The greatest contributions and advancements to civilization have directly arisen as a result of this sort of psychological determination. Goals serve to keep man's face definitely lifted toward the future. In terms of them, he is able to evaluate the diverse phenomena of his life: Social, political, educational, religious, economic, and scientific. He usually measures in terms of them the rate and the degree of his progression and his

achievement. They are psychological beacons which materially aid him in charting his course.. While he may never achieve greatly enough to realize every goal or ideal, yet he normally struggles on toward them.

Generally speaking, the greatest tragedies and the greatest sacrifices in the history of man have turned around his struggles to achieve or to maintain his ideals. Individuals have died so that an ideal might live. The histories of chivalry, religion, and science repeatedly illustrate this truth. We may see essentially the same thing exemplified today to a lesser degree in the lives of many individuals. Nogouchi, a member of the Rockefeller Foundation, gave his life in the study of fever in Africa. Moreover, we learn from time to time of men and women who have given their lives in defense of their honor. And, a short time ago, Admiral Byrd unquestionably faced very grave danger in living alone in a tiny shelter on the Antarctic wastes for a period of several months in order to advance scientific truth concerning subpolar temperatures and wind-movements.

V A Final Word

We have sought in this very general treatment to elaborate one theme, namely, that the various activities — the psychological functions — are very definitely determined by several dissimilar types of contributory or causal factors. We assume, without question, that every function of a human being is caused, and that these causes may, in many cases, be properly understood. Some of these contributory conditions appear to be set in the human organism through the nature of its protoplasm and the various patterns (structures) which it forms. The needs of sex, hunger, thirst, among others, are characteristics of a human being which can be explained only in terms of racial contribution. These are instinctive. We have tried to touch briefly upon the more general problems of instinctive determination. We have shown the necessity of accepting instinct as one form of explanation.

There are other determining conditions which seemingly exist, not because of any particular hereditary *pattern* or protoplasm, but simply because the nervous materials of man are very unstable. Particular activities are to be regarded in such cases as being secondary products. There are, moreover, several types of motives which arise in some unknown manner through the physiological

modifications produced through the use of drugs. These motives may, at times, be more powerful than those which arise through hereditary tuning. Finally, we have reviewed the motivational influence of goals, purposes, or ideals upon psychological activities. We know that an individual struggles to achieve satisfaction in various ways. His recognition of his own physical and psychological limitations together with those imposed upon him by society tend frequently to distress him. The way of Freud and his pupils appears to lead, we suggest, more directly than any other to an intelligent understanding of such troubles and to be an adequate method or procedure of relieving the individual of them.

With this fairly broad orientation behind us, we shall pass to a more detailed consideration of the various ways in which a human being functions as a total organism. We shall regard them in the order of perception, action, memory, imagination, thinking, and emotion. We shall then consider how these functions are affected through learning, and the nature of the part which they play in an intelligent and integrated personality.

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OUTLINE

CHAPTER IV. SOME VISUAL PROPERTIES OF OBJECTS

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CHAPTER IV

SOME VISUAL PROPERTIES OF OBJECTS

Among the several ways in which a human being functions psychologically with respect to his environment, some appear earlier in his life than do others. A young child is not expected to reason or think in an adult manner and to order his conduct sensibly in accordance with some definitely planned goal or end. An individual begins his life quite simply at the level of perception; and, in many cases, a major share of his life appears to be carried on at this same level. A normal individual must remember and imagine in order to maintain himself. And he must see, hear, and feel in order to move about and survive.

Perception is the earliest of the several ways in which man functions in his environment. It is, as we have said, one of several ways in which environmental objects and events are experienced by man. Through perception man grapples closely with the many things which surround him. He grasps at his world and finds that its many objects are red or green, large or small, wide or narrow, black or white, sharp or blunted, near or far, resting or moving, sweet or sour, strong or weak, strange or familiar, and fixed or changing. These significant *properties*, as well as many others, are the several *products* of man's perceptual functioning; they are what he really observes in the things which surround him; they are, in fact, what he actually *creates*, because of the very nature of his organism and his history, in his environment. "The world with animals and men left out," one writer remarks, "would be a world devoid of colors, sounds, odors, heat and cold, and pain; furthermore, it would contain no objects in so far as objects depend upon the sense organs of living beings for their existence. It would be a world comprised of electrons and protons, atoms, molecules; perhaps it would consist of electrical energy and nothing else" (21, *84*).

A. *The Relation of Visual Perception to Sensation*

a. Perceptual Properties of Objects Are Elementary. The color of an experienced object is quite elementary; it has never been reduced to a more simple, non-colorful status. Moreover, many other psychological properties such as size, shape, distance, weight, dryness, and roughness of observed objects have never been reduced to non-perceptual terms. There is no reliable scientific reason for assuming that an individual is unable at first to perceive the size — we do not mean size in any purely physical sense — as easily and as directly as he does the color of an environmental object. It is quite impossible to understand how in the beginning there could be only color without size, and how at a later date the latter could suddenly emerge. A greater degree of accuracy in perceiving the size of an object may unquestionably appear with an increase in age. It may even come between the ages of adolescence and full maturity. The same statement likewise applies to color perception. It seems quite unnecessary for purposes of scientific understanding to maintain, because a particular characteristic such as color is theoretically related either to some *physiological* process or end-organ[1] in the eye or to some purely *physical* property such as the wave-form of physical energy, that it is therefore more simple and less meaningful than many other psychological properties of an observed human or a non-human object. The observed color of an object may be neither more nor less meaningful for an adult human being than are many other characteristics of a perceived object such as size, shape, and motion. They are quite different properties; but one is necessarily no more significant than another. The significance of any property depends upon the particular needs and purposes of a human being in a particular situation. The careful chemist, for instance, does not hold that one chemical property of a substance must always be scientifically regarded as being more important than another.

b. The Inadequacy of Description in Terms of Sensation. It would accordingly seem that nothing is gained and much is actually lost, in terms of our degree of understanding, by holding to any scientific approach which forces the *meaningful* materials of psy-

[1] Pillsbury, for instance, points out that a sensation is theoretically simple since it is assumed to depend upon the action of a single sense organ.

chology into the descriptive mold of *non-meaningful* events or phenomena. Life activities whereby human beings are *psychologically* related to their world are always meaningful. Even under the most carefully controlled conditions of the human laboratory, individuals — both experimenter and subject — are always concerned with meanings, that is, with various kinds of properties of objects. The scientific reports and the descriptions given by human beings are always reducible to terms of observed properties of an environmental object or of themselves. Although he may repeatedly assert that he is not interested in objects, as such, but in the experiencing of objects, an individual must recognize that the two are at any given moment wholly inseparable. He may be interested, for instance, in *seeing*. But the *seeing* itself can be properly understood only by considering what is actually *seen*.

From the nature of the simple "eye tests" ordinarily given to most school children, the student himself can readily realize this truth. In this case, the physician tests the individuals in terms of the perceived properties of certain standardized environmental objects. He studies and measures a *functional property* of the children by way of what they see. One cannot therefore say he merely "*sees*." For one must always see something — some aspect of something. And *what* is seen is actually inseparable from the seeing unless one considers the *function* of seeing to begin and end wholly within the individual. There can be no perceptual experience, for instance, without a meaningful characteristic of some object (human or non-human) being observed. This general fact must be adequately recognized. For the sake of his understanding, the student must discard any notion that *meaningless* parts actually exist, even though they cannot be observed, and that *meaningful* experiences are composed of or derived from them. Any psychological approach that makes life understandable must begin its descriptive accounts at a meaningful level and then build upward, instead of starting at some submeaningful level in an attempt finally to reach, descriptively speaking, a solid foundation at a meaningful level. In short, psychology must recognize the scientific sterility of any approach which regards man's activities in terms of meaningless items of mind — commonly called sensations — and which attempts to put these together into meaningful situations and objects.

c. Reduction of Experience to Meaningless Items (Sensations) Is Impossible. The method of analysis in psychology is quite like that used in physics where, for example, a part of a machine or a single property of energy may be "abstracted" from the whole and described as if it were an independent unit, or in chemistry where one property, such as acidity, may be carefully studied. It is also like the method of the artist who may draw only the head or the hand of an individual. An analysis either of the *stimulus* itself or of the *sense-organs* is in no way psychological. The first kind is very definitely physical, and the second is unquestionably physiological. Both the stimulus and the sense-organs are, psychologically speaking, actually *submeaningful* phenomena. They are really causal factors. No psychologist has ever analytically observed either the stimulus or the functions of the sense-organs. That is to say, no *scientific* description of such psychological properties of objects as color, taste, or pain has ever been put in terms of some particular form of physical energy (stimulus) or of some one sense-organ. Different stimuli may thus result in the same property of environmental object being observed, or the same sense-organ may possibly be involved in the production of several unlike properties. In this connection, scientists agree that although the same sense-organs in the eye may actually be stimulated in various ways (by different stimuli), in every case the individual may see some colored object. Or, when a single small area of the human skin is stimulated, such different properties as warmth, coldness, pain, and pressure may be directly observed in the total absence of any discoverable specialized sense-organs or receptors. The same structures seemingly function in such cases to produce unlike psychological properties.

We are in agreement with others concerning this position. It is highly important, one psychologist remarks, to realize that a perception is neither a group of sensations, nor a group of sensations experienced together with their meaning (Perrin). Again, we are told that sensations are so "wrapped up and hidden from view that even the most skilled introspectionist can hardly, if at all, distinguish them; and even if he could make the distinction for himself he could not follow it with an adequate description for the benefit of others. The consequence is that the concept of sensation amounts practically to an abstraction that is enter-

tained by a few specialists at most, and that carries no discovered connection with mental function in relation to human behavior in the broadest sense of that term" (11). Woodworth remarks, too, that a pure sensation free from all recognition can scarcely occur except in the very young baby. Carr writes "that only one aspect of the complex situation is perceived at any given moment. Nevertheless, all other aspects of the situation are apprehended in a vague fashion, and we shall term this apprehension a process of *sensing*."

We normally perceive properties of an object. One property which characterizes a particular and well-known *object* may, within limits, remain fairly unchanged. When an ape has obtained food by selecting the *larger* of two boxes present in its visual field, this same box will continue to be selected even when it is placed a distance such that measured in terms of the image formed on the ape's eyes it would be much smaller than the other box which is placed nearer. Moreover, young chickens, which have been forced to select the *larger* of two grains, will continue to select the larger even when it has been placed at a distance such that its retinal area is much smaller than the area of the other grain. Experimental results obtained from young children confirm these animal studies. When trained to select the *larger* of two boxes, the same selection held even when the retinal image of the selected object was only $\frac{1}{16}$ as large as that of the non-selected object.[1]

d. The Nature of Some Products of the Psychological Functions. Since we assume that the common usage of the term sensation definitely implies the existence of certain non-meaningful processes or parts out of which the actual experiences with which psychology deals are alleged to be constructed; and, since we can find no justification, either scientific or otherwise, for holding to such a concept, we shall, therefore, consider those several *properties*, which are often called sensations, as actually referring to observable functional *products* of a living organism. That is to say, we shall regard such psychological properties of objects as color, odor, pain, pressure as being meaningful characteristics of experienced objects, either human or non-human, which result solely from the nature of the actual relations sustained between (1) a human organism with a particular personal history and (2) a life situation. They are, in short, the end-results of a certain type of human activity or function.

[1] Koffka, K., *Growth of the Mind*, p. 304.

Furthermore, we hold that the human being has *functional* properties or characteristics which are inherently determined in it — which are inseparable features of it. We suggest, therefore, that it is as impossible to explain, in final terms, why a man is able to *see* a given object in terms of its color as it is to explain why a certain substance, for example rubber or muscle, can be stretched. The student will no doubt understand that a living human being, as well as a non-living chemical substance, can be scientifically regarded as having unique properties. No one assumes for a moment that chemical substances must *acquire* their distinctive properties. Yet some persons appear to doubt that man — as a living organism — possesses any distinctive property by virtue of his long developmental history. We must be content, for the time, with the statement that it is the nature of all things to show certain properties. Color and sound, to be specific, are not regarded here as being kinds of meaningless mental elements which are *divorced* from observed objects and which consequently have no direct bearing upon life. On the contrary, they are considered always as being *actual observable properties* of a thing, by virtue of which a human being may possibly say: "Here is a *red* apple," or "There is something *moving* in those bushes."

We have said, moreover, that we shall not regard the mind in our account as being some entity which lives or exists within the organism, but distinct from it, and which manifests certain activities, *namely*, mental activities. We feel that both scientific understanding and adequate treatment of all facts demand that we take this particular position with respect to what commonly passes for mind. It is, on the whole, a simple position. Let us look clearly at it.

In treating with color from our stated position we may avoid, for instance, that very troublesome and frequent question: Where *is* the sensation of color? Is it in the eye? Or, is it in the optic nerve? Or, is it in the brain? Has it ever been observed or discovered by any scientist to travel over the nervous system, for example, from the eye to brain and out to the muscles? Or, does the sensation reside solely in the individual's mind? Is the mind, in this case, in the brain? Has it been discovered, localized, or observed to be anywhere in the organism? [1] Now, our answer

[1] "Exactly *where* is the sensation," Robinson remarks, "may be a fair question, but it is not one that the conception of the neural arc answers. It shows what kind

to all such very baffling questions is simply this: The color is not in the eye, nor in the optic nerve, nor in the brain. It does not move about over the nervous system. *It is not in the organism at all.* It cannot be found there by *any recognized method of any science* — physics, chemistry, or psychology. It is, we say, actually in the object. It is really a *property of an object.*[1] It is actually observed to be such, under *certain causal conditions*, by the psychologist. It is also observed there by the chemist who may unhesitatingly use the various colors of his chemical substances as one means of differentiating them.

This conception has much value. It serves, for instance, to relate psychology directly to other sciences. It permits psychology to share in the scientific treatment and description of the objects of the world. It places man, psychologically viewed, in very intimate relation with the objects of the world. It affords psychology a *naturalistic* approach to life problems and situations. Psychology is not to be regarded, therefore, as dealing with something utterly different from that with which other sciences deal. Various sciences may deal with some common object (source of energy). Some of its properties may be physical, some may be chemical, and some may be psychological. Each science deals at times with objects because it is directly interested in reaching an understanding of them. But it is definitely concerned at other times with certain objects because they actually give an understanding of other objects. In this way, science establishes its many relationships. Certain properties of objects, as we have pointed out, are definitely psychological. They *actually are characteristics of objects under certain determinable conditions*, just as chemical properties actually are characteristics of objects *under certain conditions*. The presence of these psychological properties is indisputable evidence of the kind of very significant relationship which exists between man himself and his world. In other words, it is a relationship which exists because of certain activities of man.

of a conducting system must be intact and functioning in order that such a fact as a sensation of weight or color or tone may occur, but it indicates nothing about the spatial location of the sensation itself." (From *Man*, 1932.)

[1] It is an observed property of an object which emerges under very definite conditions. One absolutely necessary condition is a functioning human organism. Out of the relation of human organism and source of energy there emerges an observable object-characteristic. The color does not exist except under a particular set of causal conditions. When it does appear, it is a feature of an object.

In this connection we may note a statement by Woodworth to the effect that we see a field of objects, an objective situation. We see the location, size, shape, and color of objects, their motions and changes. Similarly we hear, feel, taste, and smell objects. What we observe consists of things and events, with their qualities and relations.[1]

It is utterly fruitless, therefore, to look into the nerve cells or the muscle cells of the organism in the expectation of discovering such psychological properties. Yet no one can deny either their reality or their significance for life. It is utterly fruitless, moreover, to look for such things in the object by way of *chemical and physical analysis and treatment.* They are, in no sense, either physical or chemical. They are unquestionably of a different type. It is not scientifically desirable, therefore, to regard sensations and other so-called mental things as being "located" within the organism. They should be considered instead as being one form of functional product of the organism.[2] They are to be regarded as being *psychological* properties which at the same time are characteristics of an observed object (either human or non-human). Their description and explanation provide an *undisputable* and *legitimate* place for psychology among the several sciences. Man functions as a living organism in a certain manner under certain conditions and the world thereby directly assumes unique properties. It is the definite business of psychology to deal, among other things, with such significant properties.

Less confusion is certain to follow a shift away from the theoretical distinction occasionally drawn between sensation and perception where the sensation is regarded as being *simpler* than and *qualitatively* different from perception, and where the latter is considered to be composed of a number of the former. *A* in the following diagram represents one way of regarding this matter. Sensation, according to this way, stands always between the stimulus on the one hand and the object observed on the other

[1] Woodworth, R., *Psychology*, 1934.

[2] The student should recognize that there are many types of functional activities and products, of which two non-psychological forms are the assimilative and the excretory. No scientist attempts to understand any one of these without considering the *nature of the product.* The functions of the kidneys are understood in terms of their products. When the products change, we may say these organs are diseased or impaired. The product in any case actually represents one phase of the whole activity.

hand. Sensation is not only independent of, but very different from the observed object. The stimuli are physical wave trains. The sensations are simple, meaningless processes from which arises a perceived object. Another way, however, is represented in *B*. Here an object is directly observed in terms of certain meaningful characteristics (color, distance).

A. stimuli ⟶ brain function ⟶ meaningless sensations — meaningful object.

B. stimuli ⟶ brain function ⟶ meaningful object.

Nothing, however, is directly added to our understanding of psychological activities by maintaining that in every experience there is some sensation which is *first* aroused and is *fundamental* (non-derivative) and that the perception of something is *later* aroused and is derived from this sensation. It is from such a position, that statements of the following sort possibly issue: "On touching something in the dark," a student writes, "you may feel it as one thing and another till some perception is aroused that fits the known situation and satisfies you. Such shifts of perception, while sensation remains virtually unchanged, can be frequently observed if one is on the watch" (Woodworth).[1]

If the student will carefully study the significance of this illustration, he will most likely come to question the scientific desirability of ever raising such a distinction. He will discover that this is not a form of psychological analysis. He will instantly grant, of course, that he may feel an *object* in complete darkness. Moreover, he may observe it as being round or square, hard or soft, large or small, smooth or rough. He may immediately say: "It is a rough object," or "It is a soft object." He may also add, "I don't know *what* it is. Let's look at it in the light." Or, "Let me taste it." Or, perhaps, in addition to these particular perceived characteristics or properties of the thing, he may quickly say: "It is an apple," or "It is a rubber-ball," or "It is a wooden block." Moreover, the student may finally discover this truth: If the object is experienced in this latter way, the observer has probably gone to the greatest length possible through his perception. He has, in fact, actually *classified* the thing touched. At

[1] One also reads that our perceptions are *more* like the object than the sensations which compose the experience would *lead us to expect* (Warren and Carmichael). It is to this sort of description that we object. It does not contribute to our understanding.

the same time he has possibly arrived at the highest use to which perception may be put in science — where an individual may become so thoroughly familiarized with the several unlike properties of some object (group of objects) that a momentary glance in which he observes an object carefully is often sufficient to enable him to place a thing in its proper relationship or classification. A difference in color, for example, may mean a difference in species or race. In the same way, of course, the non-scientist may also instantly perceive a thing (a book or a human being) as belonging to a particular group or class of objects. While a single property may possibly serve in such cases, several properties, as a rule, are involved. We shall do well if we are constantly guided in our thinking by this fact: In every perceptual experience there is always an *object* which is perceived in terms of one or more of its possible properties or characteristics. But there is *never* just a characteristic — a kind of Alice-in-Wonderland grin-without-the-cat characteristic.

B. *The Relation of Visual Perception to Meaning*

a. The Observed Property of an Experienced Object or Situation Is Its Meaning. From what has been said, it should be quite evident that every human experience is necessarily meaningful. It is never meaningless. If it were there could be no experience. To experience is always to experience *something.* Meaning is to be regarded, therefore, as being an inseparable feature of psychological function. It is a product of a total situation which comprises on the one hand a source of energy and on the other hand a human organism possessing unique, inherent functional properties. We not only perceive but we also remember, imagine, or understand meanings, and we *act* with respect to meanings.

The nature as well as the amount of the meaning undoubtedly *varies* widely from time to time under unlike conditions. There is nothing strange about this fact. In the same way, for instance, the degree of acidity of a chemical substance usually increases or decreases under a change in the temperature conditions which surround it. The perceptual meaning of an observed object may include, among its many other possible properties, its color, its size, its distance, its familiarity, or its presentness. Concerning the last, we know that an individual may at times actually perceive nothing more (no other meaning) than that an object — some-

thing — is present around him or out there before him. He cannot say that the "something" is large or small, animal or human, heavy or light, harmful or harmless. But he can undoubtedly say that it is there because he heard it moving. The term "meaning" simply refers to an *observed characteristic or property of some object, situation, topic, or problem.* In short, a *perceptual* meaning may be merely the color, or the size, or the sound, or the distance of an object. To the very naïve observer, for example, the members of some unfamiliar race are actually observed to be very much alike. They cannot be distinguished. Only one property, *namely*, their *color*, is usually involved (observed) to any degree in such perceptions. The individual glances at such human beings and sees their color. The *color* is the meaning of the *race;* it immediately places or classifies the individuals. They are, then, very much alike. To perceive, therefore, is really to observe some property or properties of an object. The object may possibly be oneself; or it may be an environmental object. Meaning, we wish to say, is directly observable.

b. An Illustration and Its Significance. It is somewhat confusing to read that "it is impossible to conceive a wild man suddenly transported from the South Seas to our city block, who can *presto* perceive a high-powered automobile in the street" (11, *143*). Some very particular sort of meaning (aside from size, shape, distance, movement) must evidently be implied in such statements of this sort. As a matter of fact, we have many records dealing with savages who perceived for the very first time various objects belonging to civilized men. They most likely did not observe them in all details as did the men to whom they belonged. Neither did the latter perceive many objects belonging to the savages in the same way that their owners did; for the perceptions of any two individuals are perhaps never wholly identical. In all cases, however, color, size, shape, distance, hardness, or softness were possibly perceived properties. In neither case, however, was the particular use of an object perceived. Utility is not a perceptible property of an object. It is something comprehended. It is a meaningful aspect of an object or situation that arises out of an individual's ability to understand. It is a psychological property; but not a perceptual one.

An individual cannot look at an object belonging either to himself or to another and directly perceive its use. If he could here

would be no question, for instance, concerning the nature of many archeological artifacts about which today a great deal of controversy centers. To the inability of an organism to perceive use in an object we attribute the universal lack of tools below the human level. Even in those cases where a large ape has been taught the use of a stick to secure food, it may grasp a handful of straws and move them about in the general direction of the food. The ape can perceive, but it cannot reasonably understand in such cases. The same argument holds for children and feeble-minded persons. The perceiving of various spatial and non-spatial properties may unquestionably occur in these individuals; but *understanding* is largely lacking. The "use of an object issues, therefore, from an individual's understanding — not his perception." "The country-man tries to pull or twist the door-bell button," we are told, "instead of pushing it. He does not perceive its meaning" (32, *171*). We do not believe anyone ever could perceive its meaning. He could, however, understand it. In addition to utility, an individual creates through understanding, as we shall later show, various other meanings or properties. Certain meanings or properties are perceived, others are observed in other ways.

c. **Is the Meaning of Words Perceived?** What can we say of the meaning of words, that is, of reading? Here again we wish to make clear that words (seen or heard) belong essentially to the same category as the tool or the artifacts referred to in the above paragraph. Although a word or sentence may unquestionably possess a great deal of meaning for an individual with a certain training, he obviously does not perceive its meaning. In this case its particular value as a symbol must necessarily depend upon an individual's degree of *understanding* rather than upon his ability to perceive. In this connection, we refer the student to the animal, the child, the feeble-minded, or the "mentally" diseased. Among the latter at times can be found highly educated individuals who may possibly see the color, size, and shape of words, yet completely fail to understand them. Such individuals may also hear sounds and even repeat them correctly, yet be wholly lacking in an understanding of them; or they may be able to reproduce words by writing or tracing them, yet be without an understanding of their full meaning. In many of these abnormal cases, there may be only a partial loss. In such cases, some words (spoken, seen, or heard) can be understood, written, or spoken, while others perhaps cannot.

C. *The Dependence of Visual Perception upon Intra-organic and Extra-organic Conditions*

a. Heredity, Personal History, and Environment. Perception, like all the other psychological functions, is not definitely fixed or unchanging. It should be evident that what an individual perceives, at any time, is determined by the nature of (1) his heredity, (2) his past history, and (3) his present environment. (1) Heredity certainly sets definite limitations upon the perceptual ability of an organism. Everyone recognizes that both animal and human organisms differ in terms of their keenness of vision, hearing, and touch. The idiot is perceptually dull, just as he is intellectually dull. Other individuals seem to be normal in all ways save perhaps with respect to hearing. They cannot hear certain properties of objects. Still others, however, appear to be able to discriminate very slight differences among auditory objects. Human beings are apparently unable, as a racial characteristic, to perceive as well as certain species of animals, some of which are as low in the zoölogical scale as the insects.

(2) What he has done in his past determines in part the nature and amount of what an individual perceives. His personal history is written across the face of his perceptions. The fourth year student cannot observe the campus as he saw it the day of his arrival. He cannot see the face of his very dear friend in the way that he first saw it. It is quite impossible for him to turn back, and to become again in these perceptions as he was in the beginning. He has moved ahead. An individual's perceptions of things change: They surely grow; and they may decline. The student must realize, even though dimly, the significance of what he has perceived in the past for that which he perceives now in the present. If an individual, for example, will stare fixedly at his friend's face, that is, examine it carefully as a human face, he will come to a better understanding of the nature of these perceptual changes.

(3) Finally, a perceptual experience of an object depends upon the character of many if not all the *perceived* objects which may surround an individual at any given moment. Although he may possibly *abstract* some portion of the whole in order to describe it, he always observes a total situation, either large or small. The particular nature of what he perceives at any given moment nor-

mally depends upon the several relations obtaining among the various objects observed in his visual field. Each psychological property such as movement, color, shape, and distance of the several objects comprising a situation may be partly dependent upon other properties. Should a change occur in one of the observed properties of these unlike objects, a considerable change in the way in which an individual perceives and acts toward the total situation may possibly follow.

b. Two Illustrations: Speed of an Automobile and Fighting among Eskimo Dogs. The student should understand that one psychological property may possibly change either slightly or greatly following a change in some causal condition within the functioning thing or its environment. Without this significant fact to guide him, a student may be quite unable to find his way properly through the apparent tangle of multiple — dependent — changes. But let him thoughtfully consider, as a possible illustration, a single functional property of an animal,[1] or of a steam engine, or of an automobile, *namely*, its speed. He will very quickly discover what we intend him to understand. He will find, for instance, in the case of the automobile, that its speed as measured by the distance covered within a given time may directly depend upon (change with) such factors as the nature and grade of the gasoline,[2] the amount of air carried in the tires, the size of the gap within the spark plugs, the looseness of the pistons, the extent of carbonization, the direction and force of the wind, the character of the oil, the smoothness and grade of the road, as well as many other causal conditions which we cannot include. A person who is driving a car may not understand, therefore, the failure of his car to function as he believes it should until he realizes that some one factor, such as direction of the wind or the inflation of his tires, is actually determining its speed. An international motor-boat race was won recently by the clever maneuvering of one contestant during which time the cylinder oil of a contending

[1] Every one recognizes the possibility of increasing the speed of horse or dog solely through proper *breeding*. Speed is in part an inherently determined property that varies greatly among different animals. In this way only can we adequately account for the large differences among different varieties of the same species of animal life.

[2] The present high automative speeds are due in part to superior fuels. Such speeds were certainly not possible a few years ago when fuels were more inefficient than now.

motor cooled slightly! The resulting slower start of the second motor determined the outcome of the race.

What is generally true in the way of the speed of an object is likewise true, regardless of where it may be found, of any other functional characteristic. Consider another illustration — that of fighting among Eskimo dogs. It is well known that while in their harness and at work very little fighting ever occurs among these animals. If it does, some unusual factor must be introduced to produce such a change. But, apparently, as the harness comes off a dog, savagery seems to come on. Now, if he is not watched, one dog without serious provocation may attack another with which he has peacefully worked all day and possibly kill him. A change, therefore, in one characteristic of an object may be followed or accompanied by a striking change in another property.[1] A somewhat different object or thing may result.

c. Titchener and the Problem of Meaning. Titchener, who was interested primarily in the description of mental processes — sensation, images, and feeling — sought to differentiate them and their *meanings*. Meaning, for him, was independent of sensation. An observed color, for example, was not regarded as being meaningful. For purposes of clearer understanding, let us compare his way of regarding meaning with our way. We shall use concrete examples. (1) Titchener pointed out, for example, that a given meaning could be stripped from a *mental process*. We would definitely qualify this by saying that through a change in one or more factors in an original situation, one particular meaning (property) of an *object* can be easily and quickly stripped from it. By changing the color of an object, its original meaning can undoubtedly be greatly changed. Psychologically speaking, redness (together with other properties such as size, softness, sweetness) is ripe fruit. Where redness, for instance, is lacking in a fruit, an individual may refuse to accept it or eat it. Many other significant meanings may be changed merely by changing some one property such as the color of an object. As evidence of this point, let the student consider *color* in terms of its significance as a characteristic (innate or acquired) of different races of men.

[1] The recent work on heavy water furnishes a striking illustration. A slight change in the hydrogen side of the chemical formula results in the disappearance of old properties and in the appearance of new properties. Instead of sustaining, for example, many life forms (as ordinary water does) this new water kills them.

If Titchener had said that mental processes change, thereby changing some meaning, he would have come nearer the truth as we regard it. (2) Again, he said, a meaningless experience may take on meaning. But there can be no such thing, we suggest, as a meaningless human experience. There are, by man's very nature, only more or less meaningful experiences. We assume that the very first observations of the new-born infant have meaning. The meanings are not born in them; but the functional conditions whereby environmental objects can be differentiated are hereditarily determined. If it sees a lighted area as being different from a dark area, if it rejects a bitter object and accepts a sweet one, there is meaning. It is, indeed, most likely that the property of bitterness or of sweetness remains quite unchanged during many years of the individual's life (see Fig. 10). The amount of meaning — which as far as perception is concerned is largely the number of properties — that may characterize a particular object may be considerably increased by changing the conditions around the perceived object and within the organism. A great many illustrations of this point can be drawn from his daily life, if the student will briefly consider the many changes which appear in the same so-called "physical" objects under a shift in the nature of his desires, or his fears, or the illumination, or the point of view. (3) Furthermore, the *same* experience, Titchener wrote, may possibly have several unlike meanings. In this case, we would substitute the word "object" for the word "experience" and say that some *one* object may easily be made to show many different properties such as hue, size, distance, or motion, merely by changing either the organism or its visual field. An object which is stationary at this moment may be seen to move the next moment if an individual becomes dizzy or if he pushes his eyeball with his finger.

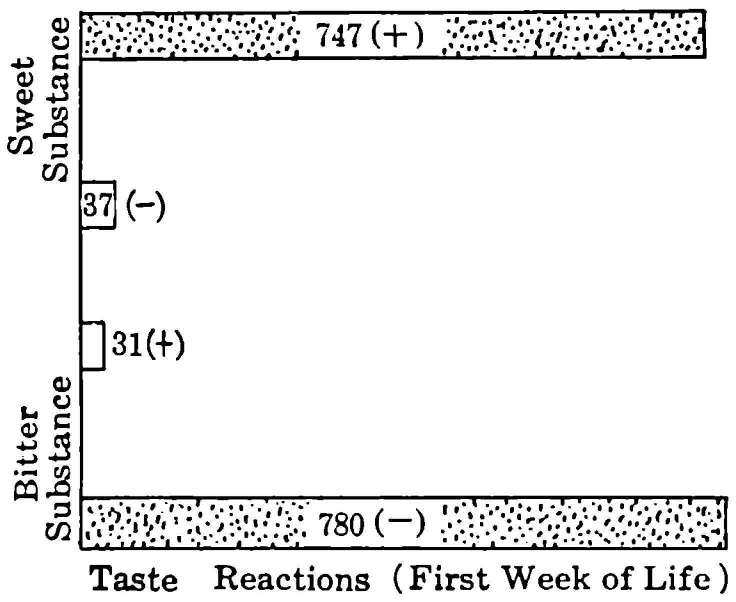

FIG. 10. Man functions selectively from the very beginning.

We are sure that the critical student will enjoy the particular illustration which Titchener himself has given in this particular connection. One may draw on the blackboard, he says, "line by

line, the figure of some such thing as, for instance, a desk-telephone. As the drawing proceeds, the lines may mean a pump, or a student lamp, or an electric portable, or a railway semaphore, or a jack, or various other things" (p. 28). The student will note that Titchener here is really talking about *objects*. Moreover, it should be quite obvious that in adding new *lines* to the old, he constantly changed the *object*. At the same time, *he changed his experience*. (4) Finally, he held that the same meaning could possibly attach to several different kinds of experiences. We can state simply that an individual may not only *see* some particular object, such as an animal, a human being, or an automobile, but he may also *touch* it, *smell* it, and *hear* it. The meaning of any object necessarily *varies* as its several possible properties *change* greatly. When new properties are added, meaning may increase. When old properties are lost, meaning may possibly decline. The loss of some one single property, such as color or sound, may actually affect the meaningful patterns, i.e., some object, to a very great degree. When a railway engineer, for instance, is discovered to be color-blind, he is immediately removed from his position. When an individual becomes unable to hear certain sounds, music may become quite distasteful to him.

D. *The Visual Perception of Objects*

Color and Light. 1. *The Properties of Hue.* The manifold environmental objects of a normal man vary greatly in terms of their many color properties. To the naïve observer, they actually appear to show an endless variety. To the psychologist, however, they fall into certain large orders or groups. Among colored objects there are some which are light red; some are dark red; some are grayish red; and some are deep (saturated) red. The same is also true of bluish, yellowish, and greenish objects. One common way of distinguishing and classifying color properties thus appears. The most apparent difference to be observed among red, green, blue, and yellow objects is known as *hue*. The few hues of the spectral band, which are *physically* produced by passing white (sun) light through a prism (see Fig. 11), range from the red end (long waves) through orange to yellow; from yellow through yellow-green to green; from green through blue-green to blue; and from blue through violet toward the red. That

is, as we pass through the series, we approach the other end (short waves) of the spectrum where ultra-violet hues are observable. At the same time, we approach objects — bands of the spectrum — whose color properties are in part like those of the end from which we started. The various hue properties may be related to each other according to the plan shown in Fig. 12. This arrangement

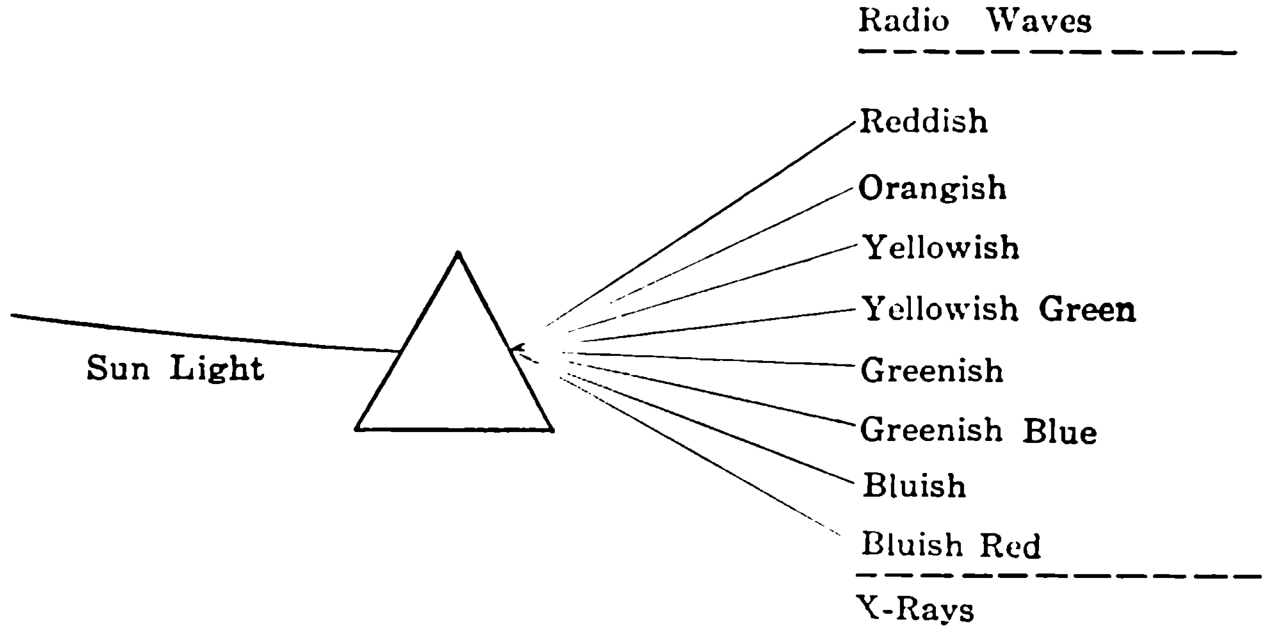

FIG. 11. "Sunlight" is composed of a number of different waves.

tends to emphasize the gross divisions or differences to be found among the red, yellow, green, and blue hues in passing from one end of the spectrum to the other. As many as 150 hue properties may possibly be represented around this square.

2. *The Properties of Tint or Brightness.* But hue is only one member of a large *family* of color properties. Tint or brightness is another member. An object, which is observed, for instance, when the source of illumination is quite weak, may be seen as being dark red. When the same source of energy is observed under stronger or more intense illumination, it has a brighter red color. These light-dark products of visual perception, other things being equal, are evidently a resultant of the intensity of the illumination. What is true of red, as in this case, is also true of every other perceptible hue. Figure 13 shows one way of representing the tint properties of objects. They apparently fall into a straight-line series with black at one end, white at the other, and gray in the middle. Under conditions of ordinary sunlight illumination, less than

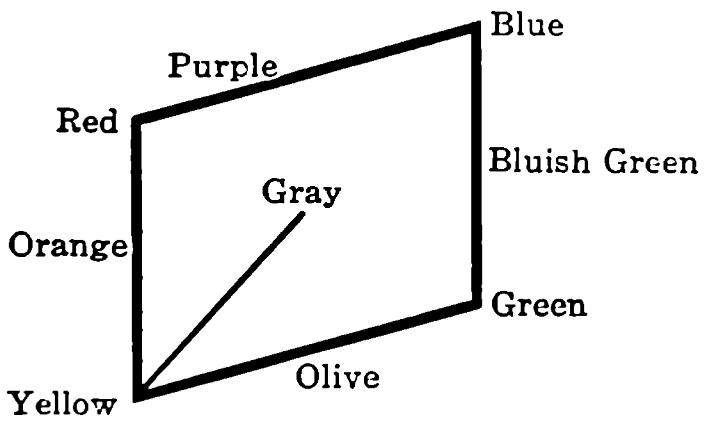

FIG. 12. A series of hue properties.

1,000 shades of black, white, and gray are normally perceptible. The tint properties of objects are definitely limited in number.

3. *The Properties of Saturation.* We know, moreover, that every colored object of an individual's environment, regardless of its particular hue or its tint, is more or less *saturated.* If the student will glance at certain wearing material shown from time to time, he will no doubt better understand this property of saturation. We refer here specifically to the so-called "powder blues" or to blues which have faded from washing. While some of these blue objects are *light* and others are *dark*, each is unquestionably a blue with some gray in it. It is, in short, a more or a less saturated blue. Every other perceptible color of environmental objects also shows this property of saturation. If the student will imagine a neutral gray being placed at the center of Fig. 12, a series of color properties showing varying degrees of grayness (saturation) can then be represented on any single line drawn from the center-gray to the place of a particular hue on the square. Some colored objects are very grayish; and others appear to have no gray at all in them. The latter sort are, we say, very saturated.

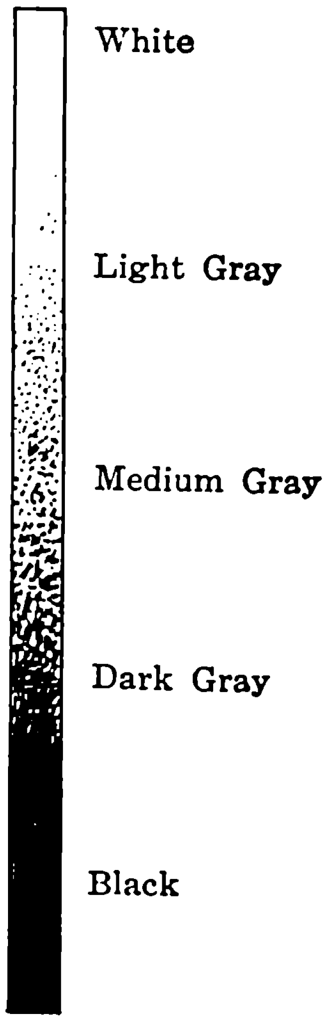

Fig. 13. Series of brightness properties.

The hues of living objects — plants and animals — are, as a rule, less saturated than the objects produced in the laboratory or in the factory. Moreover, colored objects which are deeply saturated gradually lose their saturation as their distance from the observer increases. The various hues of the object may actually change to other hues. Thus, natural objects which are perceived from a considerable distance usually appear to be bluish. Hue, tint, and saturation, then, are to be regarded as psychological properties of objects when such are visually *perceived* (produced) by a normal individual under certain conditions. The property of color is to be regarded as being an *end stage* as far as perception is concerned. The organism "reaches out" to the *source* of the physical energy which affects it and "places upon this source" a particular kind of characteristic. *Physically speaking, the color which we observe does not exist.* Physical color is a matter of number and frequency

of vibrations; observed color is psychological. It exists solely as a direct resultant of the relations sustained between a particular organism and certain sources of energy in its environment. Under certain conditions, environmental objects may be completely lacking in color properties, although their *physical nature*, as discovered by physical apparatus and methods, remains absolutely unchanged. This is strikingly true in case of color-blind people.

4. *The Properties of Objects Perceived by Totally and Partially Color-blind Individuals.* A man may not have normal color vision; he may, in fact, be totally color-blind. In this event he will still be able, of course, to see various objects around him, but they will be lacking in two color properties, *namely*, hue and saturation. He will necessarily see all objects as being black, gray, or white; that is, he will perceive only the tint or the brightness property of things. The spectral band will be perceived in this particular case as a series of grays with the brightest properties usually appearing around that region which is seen to be green by the normal sighted. The totally color-blind individual commonly — not always — sees the spectrum in very much the same way that the perfectly *normal* individual sees it in very deep twilight. The color properties of the spectrum and other objects thus depend upon certain discoverable and describable conditions inside and outside the organism.

Colorless objects, therefore, show only one kind of these properties. Colored objects show three kinds. Tint is common to both. Because of this common visual property, a color-blind man may appear to distinguish easily between two objects which to normal individuals are quite different from each other both in terms of their hue and their saturation. But a careful test, using objects which are standardized with respect to their properties, may reveal that the former is wholly unable to distinguish between a gray object and a colored object in both of which *other* psychological properties of size, shape, and brightness are identical. This common property of colorless and colored objects has tended to increase enormously the difficulty of studying the existence and the extent of *color vision* (hue properties) among animals and human beings. When vision with respect to hue is carefully studied, the property of tint must therefore be kept rigidly under control.

(a) *Illumination; and* (b) *Peripheral vision.* Every *normal* man is really color-blind in certain ways under certain specific conditions. For example, when the illumination (energy) of a light source is very weak, no hue properties can be seen in it. There is an old saying that "all cats look gray at night." Again, objects which are perceived at a certain degree of indirect — corner of eye — vision are usually completely lacking in hue. Such objects when perceived through the extreme periphery of the retina commonly possess just one color property, *namely*, tint. If a *normal* individual will observe a colored object by way of *indirect* vision, he will actually see it in terms of its properties very much as many *partially* color-blind persons would see it in *direct* vision. Its tint or *brightness* will usually be the same for both normal and partially (not wholly) color-blind individuals. That is to say, it will not usually be lower — darker — as it commonly is in the case of the *totally* color-blind person. In some forms of partial color-blindness, however, individuals may possibly see many colored objects as being somewhat darker than they appear to the normal individual.[1]

(c) *The part played by an individual's personal history.* Again, the immediate history of a man directly affects the nature of his color perceptions. He will finally become partially unable to perceive a particular hue property if for some time he steadily and constantly observes an object with that property. Every normal individual, who has for a time worn colored glasses, must undoubtedly have observed that striking visual differences exist between the old and new properties of his environmental objects when such glasses are put on. His whole visual world is immediately perceived to be different with respect to its color properties. After the glasses have been worn for a time, he may then observe that the hue, saturation, and brightness of his environmental objects are again different from what they were when he started to wear the glasses. When he finally removes the glasses, he finds that the old, familiar objects now possess new color and light characteristics. With time, these objects again assume their former perceptual properties. The time or the period of stimula-

[1] Some students have classified partial color-blindness into two groups. In the class called protanopes, the tint properties represented in spectral band are perceived to be *darker* than normal; while in the other class, known as deuteranopes, the tint values of the spectrum are like those perceived by normal individuals.

tion plays a part, therefore, in determining certain visual properties of objects.

(d) *Hysterical and hereditary color-blindness.* Cases of color-blindness may occasionally occur among hysterical individuals. Such conditions are, as a rule, rather temporary. Permanent color-blindness (weakness) appears in a relatively small number of cases in the total population. Perhaps 7 to 10 per cent of all human beings are perceptually different from others in this one respect.[1] Of this number, probably not more than 2 per cent are females. A very few of all these color-blind individuals are able to perceive only the tint or brightness of an object. Most of the 7 to 10 per cent, therefore, show only a partial color inadequacy. Usually only the reddish and the greenish properties are directly affected. The student by examining Figures 11 and 12 can more readily understand what happens to the total range of possible color properties when the red and green hues drop out.[2]

A stiff premium is laid upon color perception in certain phases of life. Artists, salesmen, dye workers, railway and marine workers draw heavily upon it. In the life of the average person, however, such perceptual inadequacies have little or no practical significance. It is assumed that many individuals actually go through life without ever realizing that they are significantly different from many other persons in one way in which they see their environmental objects. Something of the sort almost happened to John Dalton, an 18th century chemist. He happened to remark casually to a friend that the gaudy — bright red — colors of his academic gown were quite like the greens which he saw *around him in plants and animals.* From the conversation which followed, Dalton at the age of forty learned, for the first time, that he was partially color-blind. From his studies in connection with this matter, has come the term

[1] Howell points out that from 2 to 4 per cent of all males are color-blind, but only $\frac{1}{10}$ to 1 per cent of females are (*Text-book of Physiology*, p. 366, 1933). Fuchs (*Ophthalmology*) says 10 per cent of men and 1 per cent of women are color-blind (p. 244). In a recent study (*Science*, February, 1934) of Chinese students (2,279 males and 1,132 females) 6.5 per cent of the former and 1.7 per cent of the latter were found to be color-blind. Planta has pointed out that about 8 per cent of males and $\frac{1}{2}$ per cent of females are defective in color vision.

[2] The ordinary red-green color-blind individual usually sees all red, orange, yellow, and yellowish-green objects as being yellowish in hue with varying degrees of brightness. Yellow and blue may be absent without a loss of red and green properties (Fuchs, p. 244).

daltonism, which is a synonym for certain forms of color-blindness. Since Dalton's time, many standard tests have been devised to investigate this phase of visual perception. In one of the most reliable of these tests, colored spots of unlike size, hue, and tint occur on a page. The various spots are so arranged that if their hue properties are at all perceived, they will form certain definite, describable patterns. Thus the green objects, when properly seen, may form a numeral.

We have remarked that the character of an individual's previous perceptions tends to determine in part the nature of what he observes at any given moment. The various properties characteristic of the color patterns of a picture, for instance, are occasionally studied by inverting the picture. Although the stimulus relations remain constant, the color properties actually appear differently as a result of this one change in the way they are perceived. Likewise, the colors of a flaming sunset may actually become more saturated and more varied if viewed by the observer in an upside down position. In either case, the significant effects of an individual's personal history upon the particular way in which he tends to perceive objects may be partially changed through such inversions.

5. *Changes in Properties through Adaptation and Contrast.* Perceptual adaptation may also occur. When an individual becomes partially adapted to some colored object, its hue may remain somewhat constant, but its properties of brightness and saturation usually change. A bright object, for example, becomes darker, and a dark object becomes lighter (grayer).

(a) *Saturation.* A saturated object becomes less saturated; that is, it becomes more grayish in its appearance. The art critic, for instance, recognizes the possible undesirable effects of adaptation — prolonged observation — in his scrutiny of the colors of a picture; he does not expect the color properties of a long fixated object to remain fixed and unchanged.

(b) *After-images.* If he becomes adapted to any colored object by perceiving it steadily for a short time and if he then looks at a "gray" surface, an individual may possibly observe there an object of the same hue as the object he previously perceived. This new object is called a *positive after-image.* It is usually perceptible for a short time. The time is usually lengthened in those cases where the energy source of the perceived object is great. When

the organism is dark adapted (unfatigued), the intensity need not be so great in order to produce these same results. Many students have perhaps observed at night that they may continue to see the bright objects of the road-side for some little time after they have passed them. This phenomenon of adaptation apparently holds true for all hues and for all blacks and whites. Should the background upon which the object is "projected" be colored, the hue of the object seen there will be determined, in part, by the color properties of the background.

(c) *Complementary properties.* Usually after a short period, the perceived object (positive after-image) undergoes a marked change; it assumes a new property — an opposite hue. This object is in turn known as the *negative after-image.* It has the complementary hue of the originally perceived object. There are, generally speaking, two large classes of such complementary hues. There are the bluish-green and reds, and the blues and yellows. Black and white are also complementary. By matching various hue properties, many possible complementary combinations can easily be produced.

Complementary hues cannot be perceived in the *same place* at the *same time.* (Neither is one part of an individual observably hot and cold, nor rested and fatigued at the same time.) We do not, to be specific, perceive yellowish-blue objects. We may, however, see reddish-yellow objects. This kind of relationship among the hue properties of colored objects may be shown quite simply by means of rotatable colored disks. If a yellow disk and a blue disk are placed together under ordinary daylight illumination [1] and rotated at a fairly rapid rate, a normal individual will see a disk of either a yellow or a blue hue. In every case, however, the saturation is decreased. Perhaps, a powder blue is perceptible. The saturation of the particular hue that is perceived depends in part upon the relative amount of uncovered areas of the two disks. By proper manipulation of the two disks, an object that has no hue at all can be produced. The disk will be gray. When disks of non-complementary hues are properly rotated some resultant hue, which can be placed on one side of Fig. 12, is always perceived by a normal individual.

[1] A change in the illumination will produce a change in the colors. They will no longer be complementary. Moreover, if viewed indirectly, they cease to be complementaries.

(d) *Resultant properties of combinations.* Inasmuch as every student of art knows quite well that when blue and yellow paints are mixed a greenish paint is obtained, perhaps a further word concerning color mixture should be said. There is really no contradiction in the statement that this combination of blue and yellow gives gray or "white." If an individual will take two lights which can be made to shine upon a common white surface and place a blue glass filter in front of one light, the surface will then be bluish. Now, if a yellow glass filter is also placed in front of the other light source, the surface will again become colorless. The two kinds of light reach the eye together and the simultaneous stimulation produces a colorless property. This is due to the fact that the "blue" glass lets some red as well as blue waves through and the "yellow" glass lets yellow and some green waves through. Some of all the waves of the spectrum are represented together and so a colorless surface is seen.[1] If both blue and yellow glasses are placed together over the same light source, however, the surface is actually green. This same fact holds also for mixtures of pigments. When blue and yellow paints are mixed, the yellow pigments cancel the blue end of the spectrum, while the blue pigment cuts out the red end of the spectrum. Only the middle region which is *greenish* in hue remains perceptible. Physically speaking, it is not a pure green but one with yellow waves in it.

(e) *Contrast.* The color properties of environmental objects are determined, in part, we have said, by the nature of the total situation. As a direct result of the proximity of the green grass of the lawn, the red brick walls of a building are observed as being redder. They are properties of the objects within a total perceived situation. The one visual property, therefore, is not wholly independent of the other. Each color property normally tends directly to enhance its complement by making it richer (more saturated), or brighter, or darker. We recognize that women with red hair or "high" complexions do not usually wear red clothes as becomingly as do some other types. They may, however, wear certain shades of green remarkably well. Contrast effects depend, in part, upon the intensity of the illumination and upon the spatial separation of the properties. The more

[1] For an excellent discussion of this, as well as other related problems, see *Universe of Light* (1933) by Sir William Bragg, pp. 85 ff.

closely the contrasting objects lie together, the more apparent is the influence of one psychological property upon the other.

A very striking, yet simple, demonstration of contrast may be provided with the apparatus shown in Fig. 14. Here is a red light and a circular card which is divided equally into black and white sectors. The face of the disk should be strongly lighted and turned rapidly by a motor in the direction of the arrow so that there is a succession of this sort: (1) red light, (2) white card, and (3) black card. Under these conditions the change in property may be so great that the lamp is actually perceived to be greenish in hue. The contrast effect which directly arises when the white disk cuts off the light source is, in short, so strong and so persistent that it overcomes the red light. By reversing the direction of rotation so that it becomes (1) red lamp, (2) black card, and (3) white card, the contrast phenomenon does not appear. The black does not permit contrast to appear. Not enough light is thrown into the eyes.

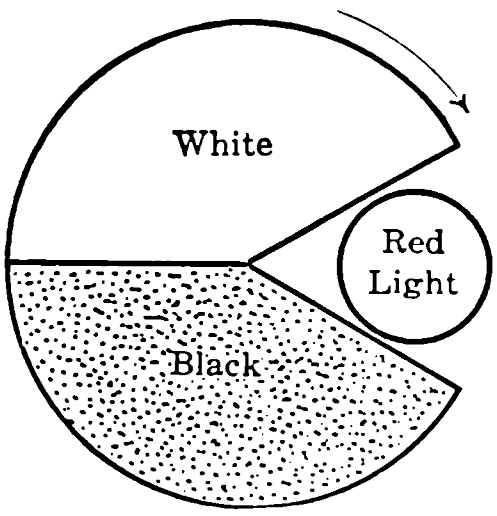

FIG. 14. Under contrast, the red object becomes greenish.

6. *Changes in Color Properties under a Decrease in Illumination: Purkinje Phenomenon.* As dusk slowly settles in one's room, and as one becomes partially adapted to the darkened conditions, interesting changes occur in the properties of colored objects which may be observed there. The tints, for instance, tend to grow darker under this decrease in illumination while the hues become less saturated. But there is something more. The blue and green properties of the objects do not change quite so rapidly in these respects as do the red properties. The former objects are, relatively speaking, both brighter and more saturated. These property relations persist as the color properties slowly become imperceptible. At the end, only tint or brightness remains. The objects are now grayish. Moreover, the object which was formerly green now appears to be the brightest gray. This shift is known as the Purkinje phenomenon.

By this time, one fact should be very apparent to the student, *namely*, that color perceptions are not fixed and unchanging. In this respect they are quite like the functional properties of some chemical substance — an explosive — which may possibly show

a very great change in one of its properties with a slight change in its environment or in another property. The perceived color properties of objects should be regarded as being intimately dependent upon several unlike conditions, some of which are inside the organism while others are outside the organism and around the object (source of energy).

7. *Color Zones.* Changes in the color properties of objects appear with a change in the particular area of the eye which is directly employed in perception. They may be determined by a perimeter (see Fig. 15). Through one part of his eye an individual may perceive certain properties; through another part, other properties may be observed. When the central portion of the normal retina is functionally employed *all* color and light properties are perceived. When the area lying outside this central region is involved, yellow, blue, and gray objects are commonly experienced; and when the extreme, outermost region (periphery) of the retina becomes functionally concerned, only the tint or brightness properties of objects are usually perceptible. What is observed here depends partly upon the time of stimulation, since a longer period is required for the perception of hue properties in the periphery. There is also dependence upon the saturation of the color. A fully saturated object may actually be perceived through the extreme periphery of the retina, provided the *intensity* of the illumination is greatly increased.

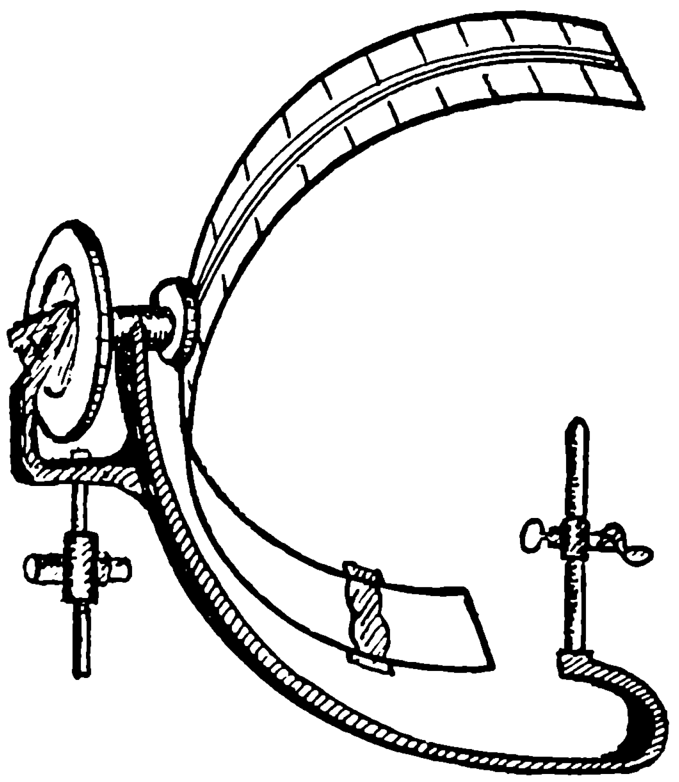

FIG. 15. A perimeter (used in studying certain visual functions).

The so-called color zones (Fig. 23) of the human retina possess considerable psychological interest because they serve to emphasize the fact that a color property of an object which may be perceived *at any one time* is quite dependent upon the interrelation of a number of causal factors, each of which may possibly vary more or less independently of every other. The richness and the diversity of perceptual products should now become more easily understood. A thing can be fully understood only in terms of its relations to other things or properties. We have seen that the perceptual

properties of objects, like all things in science, are different upon successive occasions when unlike causal conditions prevail. With that clearly understood, we can approach the task of explanation. We shall now draw in particular upon what we said in general in this connection in Chapter I. We accordingly go to *physics*, *chemistry*, *physiology*, and *psychology*.

OUTLINE

CHAPTER V. AN EXPLANATORY APPROACH TO VISION

A. The Problem of Causation
- a. Causation in the Physical and the Biological Sciences
  - 1. Causal Factors May Vary
  - 2. The Significance of History as a Causative Agent
    - (a) Man's organism is not inert
    - (b) Rôle of racial and personal determination
- b. The Stimulus
  - 1. Its Nature
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  - 3. Does It Account for Uniqueness of Psychological Properties?
- c. Functional Levels
- d. Stimulus and Perceptual Product
  - 1. Is There a Stimulus for Each Property?
  - 2. Does Man Observe Stimulus?
  - 3. What Does Man Observe?
- The Organism Always Responds to Properties of Objects within a Total Situation and Not to Stimulus
  - 1. Does an Individual Select Stimuli?
  - 2. Two Illustrations
  - 3. Difference between Biological and Psychological Selectivity
  - 4. Does Man Respond Psychologically to Stimulus?

B. Vision as Explained by Physics
- a. Nature of Light Waves
- b. The Physical Basis of Hue, Brightness, and Saturation
- c. Some Effects of Light Waves

C. Vision as Explained by Physiology
- a. Rods and Cones
  - 1. Day and Night Vision
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- b. Color-Blindness
  - 1. The Father and His Children
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  - 1. Why Is the Periphery Usually Color-Blind?
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D. Vision as Affected by Psychological Factors
- a. Rôle of Personal Past
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CHAPTER V

AN EXPLANATORY APPROACH TO VISION

A. *The Problem of Causation*

a. Causation in the Physical and Biological Sciences. It is evident that the physical conditions which surround a human being play a significant part in determining the nature of his perceiving. Although perception is intimately related to extra-organic conditions, the latter cannot properly be regarded as being *the sole or the primary cause* of color perception; for, as we have already shown, a fairly large number of intra-organic factors also enter into and determine in part every visual experience of an individual. At this place we should like to point out that, upon examining the relation of one event or property to another, the student will discover an outstanding difference between the sciences of psychology, physiology, and zoölogy on the one hand, and the sciences of physics and chemistry on the other. He will discover that, characteristic of the latter sciences, the quantity of the consequent (effect) usually varies directly and fixedly with the quantity of the antecedent. In fact, in a great many cases an exact mathematical description of this relationship may be given. For instance, when the pressure exerted upon a stream of water is varied, the distance of its flow as well as its force will directly vary with the pressure. Or, when the temperature of a gas is raised, its volume increases in a definitely fixed manner. A precise quantitative — mathematical — description can be given of this resultant change in the property of a physical and chemical substance.

In the biological sciences, however, a slight change in a causal factor may possibly produce either an enormous or a slight change in the functional properties of a living organism. In these fields, the quantity of the result may not vary directly and in a very definitely fixed manner with the quantity of the antecedent. Everything that is known about the various psychological activities of a human being points in this general direction: That which

goes on, or has gone on inside it, is frequently more important as a determining factor of its activity than that which goes on outside it. If the student will consider briefly the relative importance of such factors as his set, his needs, his purposes, his intentions, his desires, and his interests in the determination of his perception of objects — what he sees from time to time — he will better understand this point.

If the student should uncritically assume that the particular kind of relationship which is to be found in physics must necessarily exist in every case in order that some principle of scientific causation or relationship may be established, he will never understand psychology. Neither will he be able to understand the other biological sciences. In no one of these can precise generalizations or mathematical laws be found to the same degree as in physics and chemistry. Both the materials themselves (non-psychological or psychological) and the mode of causation are actually different. Although *every* event or activity *must unquestionably have a cause*, all forms of causation are not alike. The student must properly realize the very great importance to be attached to the *one* fact that man is truly a historic being; and that his history contributes enormously to the determination of his every activity. The human organism cannot be properly understood apart from its history. It has both a personal history and a long racial history. Man is a dynamic organism; and he meets his world in a decidedly active manner. Each activity which he may manifest is, within limits, significantly predetermined or prepared beforehand to a greater or less degree for that (energy) which comes to the organism from the outside. It is certainly not by sheer chance or by accident that men are very much alike in such functions as perceiving, remembering, and thinking. They are also alike in their biological functions of digestion, assimilation, etc. They possess a common racial heritage, which stands at all times as a primary determiner of their functions. But, the student may ask, what about the physical or chemical *stimulus* which acts upon the organism?

b. The Nature of the Stimulus. This brings us face to face with a very fundamental problem. How shall we regard the relation of a stimulus, which we consider as being some form of physical, physiological, or chemical energy, to the activity of a human organism? Shall we attempt to consider the *latter* as we would

some chemical substance, and deal with it as if it possessed only those properties common to chemical substances? Should we do so, we shall be forced either to drop the concept of stimulus or to employ it unscientifically. Properly speaking, no chemical substance is ever stimulated. An acid, for instance, cannot be scientifically regarded as stimulating an alkali. Neither does sunlight stimulate a sensitive photographic plate or the fresh paint on a house. Loeb, for example, bathed unfertilized eggs of animals in acids and salt water; and they grew without ever having been fertilized by a male cell. Yet, strictly speaking, Loeb did not think of these eggs as being stimulated. The bathing merely permitted certain biological functions already *in operation* in the egg to be accelerated. We can safely say, then, that one chemical may produce a change in another chemical; but, we cannot say that the one stimulates the other. Our understanding of man is not materially aided, therefore, by holding to a strict chemical interpretation of the stimulus in its relations to his activities.

Shall we, therefore, regard the human being as being a biological structure which possesses certain properties somewhat different from those of non-living chemical substances; that is, shall we regard it as a living creature having some properties which are common, in certain fundamental respects, with those of every living creature? If we do, we immediately provide a place for the stimulus in our explanatory scheme of human behavior. Viewed from this particular angle, the significance of the stimulus seems to concern mainly its value as a causal agent which serves to increase or to decrease the several *functions of a living organism.* The various fundamental functions of the organism push on *continuously;* and their rate and their direction are unquestionably determined in part by the stimulus.[1] In short, the stimulus really serves *to produce a change in a human organism as a direct result of which some property of an object (human or non-human) emerges and is observable.*

[1] Some comments by Starling in this connection might be helpful. He remarks that (1) the connection between stimulus and response is so indefinite that dependence is placed entirely upon introspection in the study of the effect of stimulus upon sense-organs; (2) the character of experience bears no resemblance to the physical conditions of the environment; and (3) many different stimuli applied to the sense-organ may result in the same quality being experienced. Stimulation of retina, or the optic nerve, or the ends of the nerve in the brain gives the same result (*Principles of Human Physiology*, 1930).

A very important question arises here. How can such psychological properties as these exist? How are they possible? We have but one answer (and we speak in the voice of each science when concerned with its own materials): It is a *unique* and inherent functional property of a living organism to make such characteristics or products possible. No scientist has ever succeeded in reducing to any other status those fundamental properties which are peculiar to any given substance. The student must be guided by this significant fact: Certain materials of each science show *unique* properties. This holds true for psychology. The human

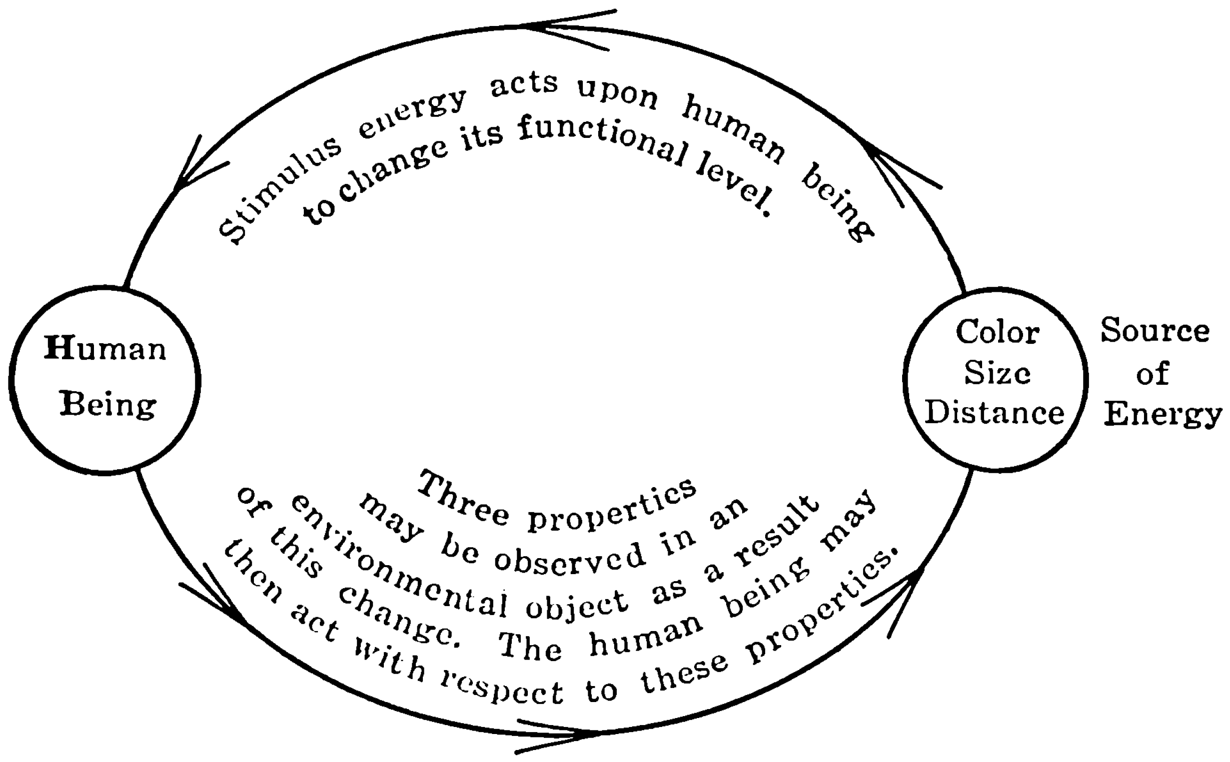

FIG. 16. Energy produces a change in the functional level of the organism.

being, functioning in its own ways, directly contributes in part to the objects of the world certain definite properties which are wholly unique. This is merely to say that when man is lacking, such particular properties do not exist. The human organism in a sense "creates" (causes), as a result of certain activities carried on within a total situation, some characteristics of things which no other living creature ever does. Because of the way man functions, objects possess new faces or new characteristics or new properties. We do not imply that man literally creates and pastes such things upon objects. Man actually serves as one form of causal agent necessary to produce such naturalistic properties. They exist because of man. In certain respects, however, man and animal are quite alike. Regarded as total biological organisms, they have some psychological functions in common. In the same way, to use an analogy, they have certain physiological

functions in common. But living organisms differ physiologically; they also differ psychologically.

Perhaps the diagram in Fig. 16 will make this point clearer. A human being is shown to be affected by a form of physical energy coming from an environmental source, and as a direct resultant three properties, *namely*, color, size, and distance of an object, are observed. To illustrate in another way the nature of the stimulus we wish to refer to a statement by Hatcher of the Cornell Medical College, who writes of the value of a drug injected into a human being: It is a "substance that increases or decreases the function of one or more organs or tissues. It may do either of these primarily, and then the other, but it is far more common for stimulation in some degree to occur first and to be followed by depression. The stimulant change varies from that which is hardly perceptible to violent convulsions, and from depression that is equally difficult to perceive to that causing paralysis and death."[1]

We know that adrenalin, when properly applied to the heart of a dying man, may serve to hasten its functions. But it does not start life; for we must recognize that no agent, regardless of its nature, has ever started life or life functions. Again we know that such factors as *lowered temperature, decreased oxygen supply, disappearance of water, or anaesthetics*, as well as many other conditions, will bring about a remarkable slowing down of the various functions of a living organism, either human or animal. Now can such conditions be properly regarded as being stimuli, even though, in the more common usage of the term, they do not *stimulate?* If we hold to a functional point of view, we must unquestionably accept them as being forms of stimulus agents. Properly regarded, they are quite as stimulating as are those other conditions which serve to hasten or increase the rate of functioning. That is to say, they serve *to produce changes* within an

[1] Hatcher, R. A., *Alleviation of Suffering* (Chemistry in Medicine), p. 495.

J. G. Coulter in his textbook, *Plant Life*, writes: "If we remove the effects of gravity, roots *continue to grow* in whatever direction they may have started. To observe the result of removing the effect of gravity, sprouting seeds may be pinned to an upright revolving disk, being kept moist by dripping water. As the disk rotates, each seedling constantly changes its position with reference to gravity. It occupies no one position long enough for an effect to be produced. Thus the effect of gravity is practically removed, and the result is that both roots and stems *continue to grow* in whatever way they began, at least *so far as gravity is concerned*" (p. 133). Gravity does not stimulate the roots to grow. It does, however, determine the direction of growth.

organism. An increase, as well as a decrease in function may be the result in part of physical and chemical energy.

We shall speak, therefore, of certain physical and chemical conditions which exist outside the organism and of certain *physiological* conditions to be found inside the organism as being stimuli. And by stimuli we shall simply mean those various conditions, whatever their nature, which act in part to change *a particular functional condition of the organism.* Unlike a machine that may be thrown in and out of gear, an organism necessarily functions, we assume, *during every moment* of its waking and sleeping life. As evidence of this fact let the student attempt to find a single moment during the day when he is not seeing, hearing, or feeling. He will discover that he is always functioning. Even in a light-proof, soundproof room he may see, feel, and hear. His retinal functions, for instance, will run on even under conditions of complete darkness to give rise to various visual properties; or, he will perceive the various movements of his body and the rustling of his clothes. If he lies perfectly quiet, he may possibly perceive the beating of his heart and the rushing of the air into and out of his lungs. If he holds his breath, other properties will immediately become observable. If a change is made in some particular *energy* phase of the total situation, it may be followed by a resultant change in the level or in the direction of his perception. This may simply mean that a newly perceived property or object is either *substituted for* some previously observed property or object, or merely *added to* that which was previously perceived. As a result, he may now observe that his back aches or that an electric bell is ringing. We assume, furthermore, that the nervous system of an individual is *continuously* functioning. While it may possibly work at a sub-observational or submeaningful level, it is always an active dynamic agent that continuously operates as a determining factor in man's activities, whether they be of a psychological or a non-psychological nature.

c. Functional Levels. At times, the functional level of an organism is apparently so near that which is necessary in order for some object to be perceived that an astonishingly small amount of physical or chemical energy, introduced from the outside, may bring it to an observational level. Some individuals, for example, so sleep that they may be instantly awakened by a softly whispered command. Others seem to fall into such deep slumber that it is

very difficult, if not impossible, to arouse them (see Fig. 17). The essential differences between these two extreme cases are to be put in terms of the functional level of the particular organism. In the first case, the individual's nervous system is apparently functioning just below the level necessary for perceiving. He hears, therefore, every object in his environment except possibly the scurrying mouse or the chirping cricket. In the second case, the functional level of the nervous system drops (like the several physiological functions in a hibernating animal) so much that the individual apparently approaches a stuporous condition. We hold, therefore, that the physical conditions of the environment do not actually start neural functions of a human being. They serve merely to hasten, or retard, or change the direction of its functions. The most common measure of the depth of sleep, for instance, is the amount of physical energy required to bring an individual to a perceptual level, that is, to change the activity level of the organism; this involves a change in the nature of the *relations* between an organism and its environment.

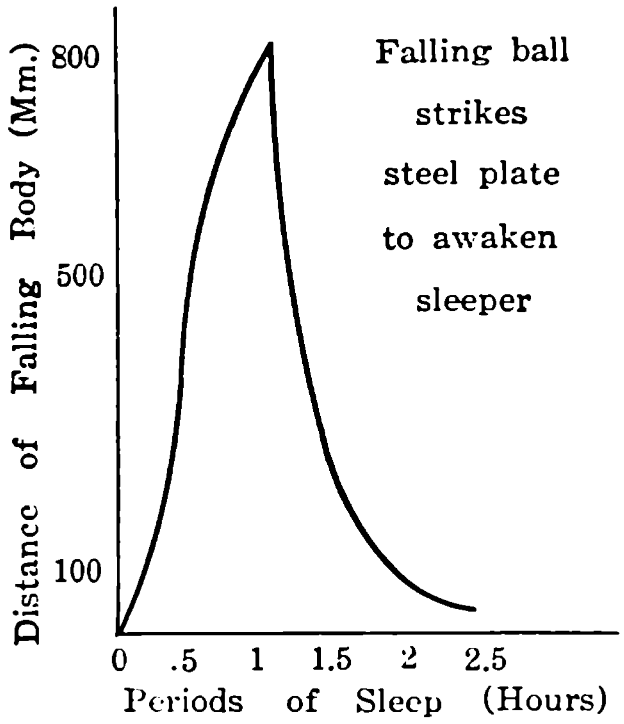

FIG. 17. More energy is necessary at certain time to produce functional change.

d. No Specific Relation between Stimulus and Perceptual Products. For an intelligent comprehension of the facts and the nature of psychology, the student should duly recognize the impossibility of holding precisely to the notion of specific physical and chemical stimuli which act upon specific sense-organs to produce specific motor responses on the one hand or sensations on the other. If he will very briefly consider the wide range of the observable psychological properties of himself and his environmental objects, which include, among many others, those of touch, pain, hunger, fatigue, temperature, thirst, dizziness, movement, distance, smell, nausea, and depth, an individual will be unable to find in any particular case, either a *specific form of physical energy* to stimulate or a *specific sense-organ* to be stimulated in order to produce either a specific sensation or a bodily response. That is to say, no specific sense-organs have ever been found by

anatomists which may be held to be excited by a specific stimulus to give rise, for example, to the unlike cutaneous properties of warmth, coldness, and pain. It is quite possible in these cases that *unlike* forms of energy act upon the *same undifferentiated nerve-endings* to produce these different psychological properties. We suggest, therefore, that by starting our descriptions at a meaningful level — not at the level of either stimulus or sense-organ — we may possibly avoid the necessity, as we proceed, of repeatedly shifting from one level of description to another. As a matter of fact, we always *observe* properties of objects — not stimuli and sense-organs. And we always act with respect to these particular properties — not to stimuli and to sense-organs. It is to be noted then that we act as a *result of stimuli and sense-organs as well as brain, history, expectation, set, fatigue, purpose, instruction, and adaptation.* All these, in addition to other factors, affect the manner in which an individual functions.

e. The Organism Always Responds to Properties of Objects within a Total Situation and Not to Stimulus. We shall not regard the human organism, then, as reacting, in the more traditional sense of the word, to the various forms of physical and chemical energy which reach it from the environment. Carr, for example, has pointed out that a perceptual object does not necessarily involve the presence of an objective material stimulus (p. 111). We recognize that a stimulus may unquestionably affect a human being although nothing may be observed. The intermittent alarm clock, the continued ringing of the recess bell by the teacher, the dripping of water from the eaves illustrate this point. One buzz, one ring, or one drop is not enough. Yet added to the others, it serves to raise the functional level of the organism.

We shall assume that the organism normally functions *continuously and always in some direction.* It cannot possibly stand still. During the course of his waking life, an individual necessarily responds in many unlike ways to his environmental objects, but always in terms of their several psychological properties. He does not respond psychologically in terms of the physical properties of the stimulus. The student will be well guided, indeed, if he constantly understands and recognizes the very fundamental difference which exists between the stimulus (physical energy) on the one hand, which neither he nor his instructor ever observed under any condition, and the various properties of the perceived object

on the other hand, which both may possibly observe. He will better understand that it is *utterly impossible* for any human being or any animal to *select or to pick out* the various kinds of stimuli (energy) which impinge upon *it*. Psychologically speaking, the organism can unquestionably select or perceive certain objects, in terms of their several properties, among the many which may possibly surround it, and at the same time exclude certain other objects. It can, moreover, act in many unlike ways with respect to these properties. To clarify this matter, we give Fig. 18. When moving over clear shallow water, an individual will often see the water to be very shallow ahead of him and behind him,

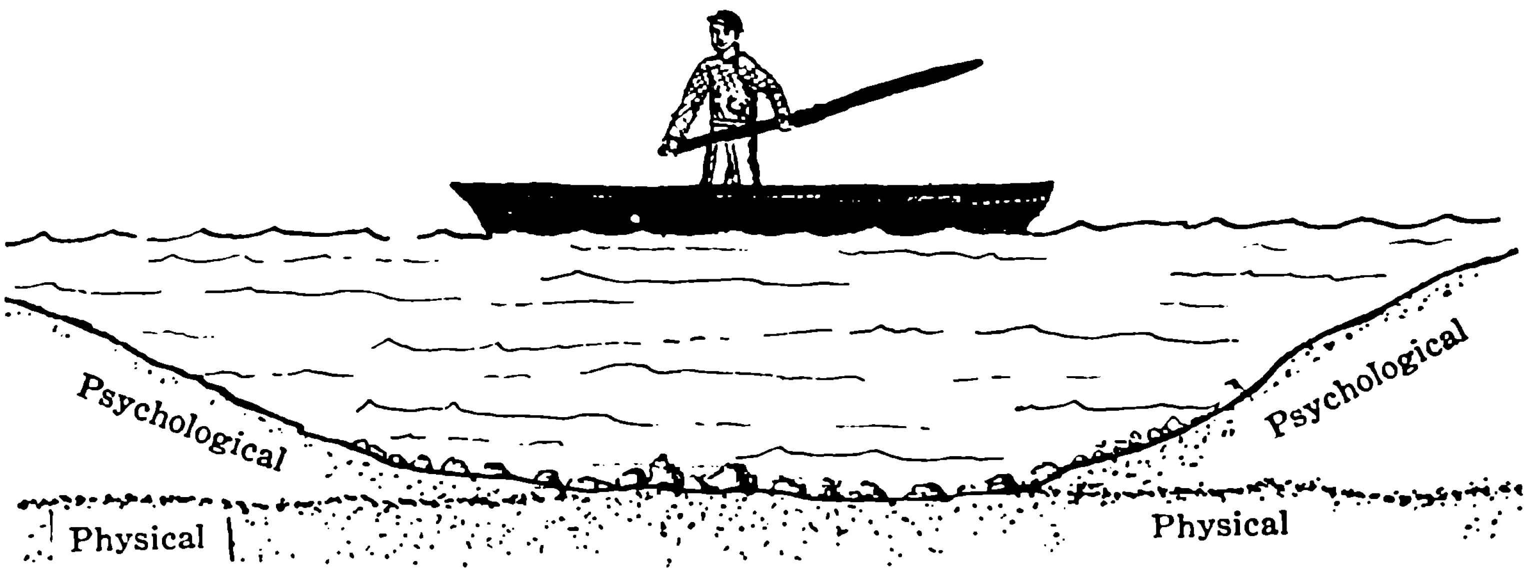

Fig. 18. The man observes an object in terms of its psychological propertie. Diagram path of light rays.

but deeper below him. As he moves ahead, the water is perceived to be deeper. Now, if the student uncritically assumes that he actually observes light in terms of its *physical* properties, let him show upon this figure by diagram the exact manner in which the physical light travels from the ground to affect the man in the boat so as to produce *his perception of the position or distance of the ground* (as shown here and labeled psychological). Physical ground is represented as being level.

When a normal individual opens his eyes upon a crowded street, millions of light waves streaming from literally thousands of different sources of energy may strike his retinas. He can actually do nothing about it; and, as a matter of fact, he directly knows nothing about this *extensive* bombardment. Yet, despite all these unlike stimuli (forms of energy) which necessarily act in a purely physical and mechanical manner upon his open eyes, *he may not perceive any object.* We can unhesitatingly say, therefore, that man's different *sense-organs*, which are microscopic in size, mechan-

ically "select" certain stimuli, because they are, very broadly speaking, biologically tuned to different forms or kinds of energy. That is, they operate *differently* with respect to different forms of physical and chemical energy. In somewhat the same way, we can say that an ordinary *sieve* actually selects some objects and at the same time rejects other objects which are placed in it because it has been definitely prepared previously to select certain objects.[1] The stimulus is important in being *one possible cause* of the activities of living organisms, but it unquestionably operates below the meaningful level of function. We shall return later to this topic when we refer to subliminal stimuli.

The determination of activity is in all cases more intra-organic than extra-organic. There are, in short, more intra-organic factors than there are extra-organic. While extra-organic conditions may take many forms, they seem in each case to serve merely to hasten, retard, or change the course of function with respect to some object. Thus we recognize that an individual may perceive color properties when his eyeball is pushed, when his head is bumped, when an electric current is passed through his eye or his brain, when the blood rushes to his head, and when he is suffering with certain physical and psychological diseases. We also recognize that a slight disturbance or a change in the nature of one psychological activity of the organism may directly involve other functions to a major degree. This fact becomes very evident in an abnormal personality.

B. *Vision as Explained by Physics*

Light Waves. Light waves constitute one phase of an organism's physical environment. These waves are extremely short; and they travel so very rapidly that one of them properly conducted could encircle the equator about seven times within a second.[2] No individual — not even the physicist — has ever perceived this form of energy. If the physicist had, there would

[1] A wire fence is unquestionably selective or discriminative. It allows small objects to pass but turns back larger objects. It is definitely prepared for this particular task.

[2] The longest effective wave is 760/1,000,000 millimeters; the shortest is 390/1,000,000 mm. The longer vibrate more slowly than the shorter. Imagine a human eye capable of perceiving things as tiny as these "waves"! Pillsbury remarks that we make little use of wave lengths of light in our descriptions of colors. The observed color laws do not have a close correspondence to changes in these lengths.

undoubtedly be greater certainty concerning the exact nature of light. The physicist, like every other man, observes directly only the perceptual *properties*, such as hue, of his environmental objects. The fact that a man is a physicist does not imply that his ability to perceive, as measured in terms of limits, is increased in the slightest degree.

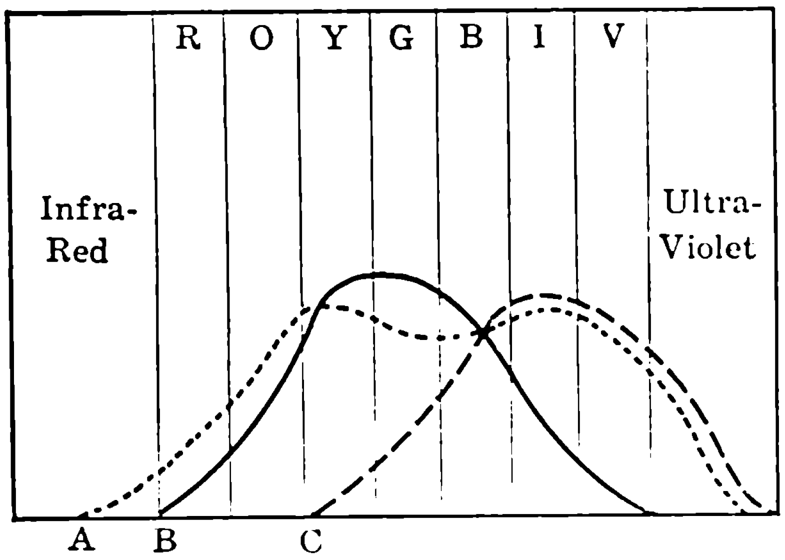

FIG. 19. In common with other things, light waves are known in terms of their effects.

The perceived hue of an object varies roughly with the length of the light wave. The longest waves (see Fig. 11) are roughly related to the red hues, and the shortest waves are related to the blue (also red) hues or objects. The tint or brightness varies, within limits, with the intensity of the waves. The degree of saturation depends in part upon the "purity" of the waves — the highest degree of saturation of given olor property of an object is presumably related to only one kind of light wave. White light, that is, what is ordinarily called sunlight, may be analyzed or broken up," physically speaking, into a number of unlike waves (see spectrum). But this is not psychological analysis.[1] Psychologically

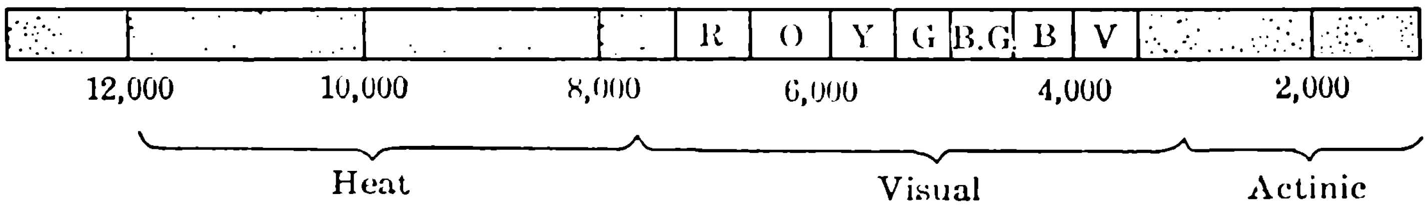

FIG. 20. Three ways in which physical energy affects man.

speaking, no one has ever *seen* sunlight. During the day, an individual merely perceives the sun and other objects. He sees these latter objects as having certain properties (size, shape, color, etc.) which they may lack at other times. Figure 19 shows three types of changes resulting from sunlight as determined by the nature of its effects upon the eye (B), an ordinary photographic

[1] The rainbow is a psychological resultant of perception. Physically speaking, it is the result of the breaking up of light rays which strike the top of raindrops and emerge at the bottom of them partially dispersed or analyzed. Because of this physical "analysis" of white light by water, we perceive a colored object in the sky. The rainbow is interesting because, physically speaking, the properties of the stimulus are exactly like those in every other visual experience. Yet uncritical students often assume that the rainbow does not exist.

plate (C), and a specially sensitized plate (A). The physicist, for instance, observes only those properties represented by *B*. Figure 20 shows three large groups or kinds of physical waves. Most heat waves have no visual effects. The actinic burn; but one does not directly observe them.

C. *Vision as Explained by Physiology*

a. Rods and Cones. Among the several physiological factors involved in color perception, the functions of the rods and cones which are commonly known as the sense-organs of vision play an important rôle. The specific nature of the various physiological changes which occur in the rods and cones under physical stimulation is unknown. Some scientists assume that, in addition to chemical changes, the end-organs slightly contract under intense illumination and extend under weak illumination. Again, a substance — visual purple — which some maintain causes vision to be more accurate is possibly formed in some of the organs, principally the rods, during periods when the eye is unstimulated. It is apparently true that after an individual has been in darkness for a period less than an hour, he is usually several thousand times more able to see certain properties than he is after he has spent several hours in very bright sunlight. Visual adaptation under ordinary night darkness seemingly proceeds with extreme rapidity at first. Within a period of about fifteen minutes, the greatest part apparently occurs. The adaptive changes then continue slowly over a period of possibly several hours.

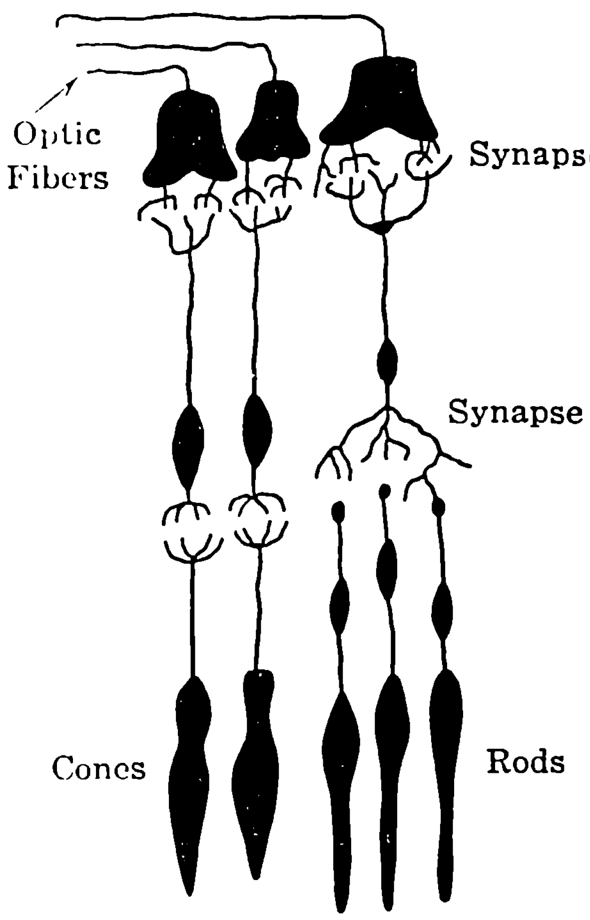

Fig. 21. A diagrammatical sketch of rods, cones, synapses, and optic fibers.

From the rods and cones (see Fig. 21) lead the fibers of the optic nerve which connect them with the cerebrum (brain).[1] The rods

[1] The human eye represents in part a portion of the brain that has been pushed to the surface and developed. Like the brain, the retina of the eye has reached most of its growth at the time of birth. Figure 27 shows the relative position of the eyes in a human embryo of one month. With time, they migrate to the front of the face.

are regarded, by many, as being largely or wholly concerned in the perception of the *light* properties of an object when it is observed in weak illumination, under which conditions, as we have said, the *hue* properties are lacking. Rods apparently predominate in the retinas of some nocturnal animals such as owls and cats. When the intensity of the light waves which reach the retina is increased, the functional level of the cones is thereby raised, and with their operation the several color properties of an object become perceptible.

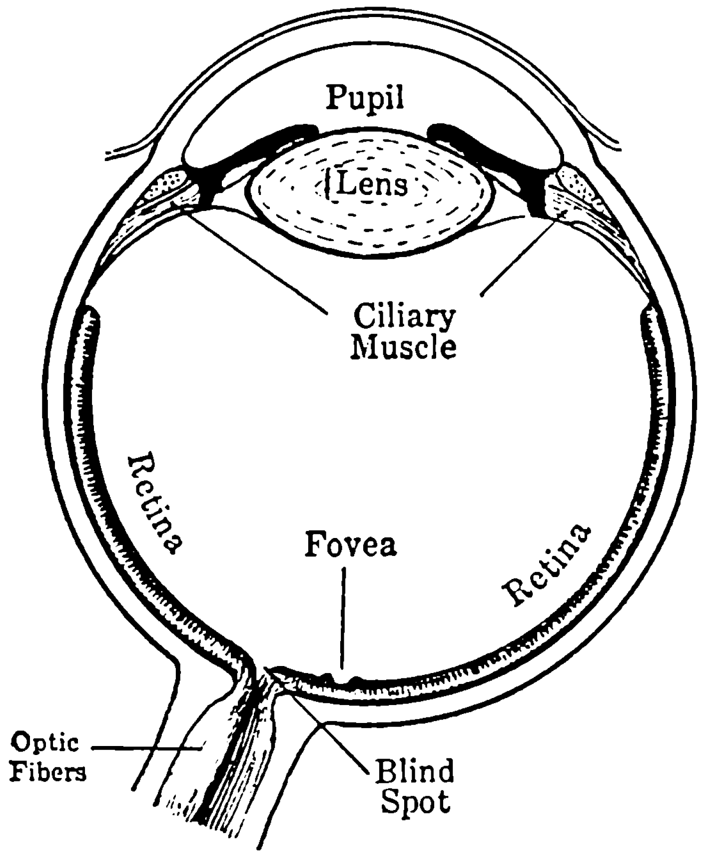

Fig. 22. A sketch of some of the significant structures of the human eye.

That region of the human retina (see Fig. 22) known as the *fovea*, upon which the light waves impinge when the eyes are fixated *directly* upon an object, is chiefly composed of cones.[1] This is apparently the point of clearest *daylight* vision. In the normal daylight eye, it is, perhaps, thirty times more sensitive to light waves than the non-foveal areas are. But the foveal area seems to be functionally indifferent under very weak illumination. The astronomer, for instance, understands that a very faint star directly fixated, thereby involving foveal vision, becomes imperceptible. For all such observations, he accordingly looks slightly to one side of the star. Under dark adaptation, therefore, the periphery is considerably more sensitive than the fovea. That is to say, it is more easily lifted to a perceptual level. Less physical energy is *now* required as stimulus. The cones become increasingly fewer in number as the periphery of the retina is approached. In the extreme peripheral regions they are largely lacking and here, as we have said, there may be no color perception.

b. Color-blindness. When the functional level of the retina, particularly of the cones, drops, color-blindness occurs. This may *normally* happen under several conditions. It may also occur as a result of certain permanent hereditary determiners. These

[1] All *mammals* below the zoölogical order to which man belongs are reported to have no fovea. Some birds, curiously enough, have two (Herrick).

hereditary conditions appear to affect individuals in accordance with fairly well-known principles. A color-blind father, where the mother is *wholly* normal, cannot produce color-blind children. His possible sons and their sons are completely free of any color-blindness. Moreover, no daughter would be color-blind. But certain of his grandsons produced through his daughters would most likely be color-blind. In terms of hereditary determination, ordinary color-blindness is generally regarded as being a sex-linked characteristic. As one result of heredity there may possibly be no cones in the retina; or, the cones may be present but are not functional, either in part or in whole. Most students assume that totally color-blind vision is really *rod* vision. But, if this were wholly true, there would, of course, be no *foveal* vision at all in totally color-blind individuals. They would be unable to see an object when their eyes were fixed directly upon it. This, however, is *not* true probably about as often as it is true.

c. Contrast and Adaptation. The several physiological functions of the human retina which are involved in such visual phenomena as adaptation and contrast are explained in part by Hering in the following manner. The rods and cones are the seat of six unlike physiological functions. These may be regarded as falling into three complementary pairs. In *each* pair, two inseparably related but antagonistic functions serve to produce two properties, *namely*, red and green, or blue and yellow, or black and white, together with many other properties. The continued perception of an object of a given color property, such as *blue*, will directly result in a gradual reduction in the retinal function involved in seeing this colored object. At the same time, however, there is a gradual heightening, under continuous stimulation, of the opposed retinal function which is concerned, in this specific illustration, with the perception of an object of *yellow* hue. Since the whole visual field must be regarded as being a highly integrated functional pattern, every non-colored object which occurs in the psychological environment of the fixated blue object may actually be perceived to be yellowish in hue. This enhancement of a particular, opposing visual function, whereby the color properties of objects are directly affected as a result of the continued stimulation by an unchanging physical source, constitutes the physiology of visual contrast. Although the other objects which immediately surround the fixated object are perceived to possess certain hue

properties, which are relatively independent of the hue of the fixated object, yet each tends in accordance with the effect of the opposing retinal function to be affected. As a result, many unlike hue properties may be observed among the neighboring colored objects. Under the gradual reduction in the retinal function above referred to, the perceived hue of the fixated object gradually becomes less saturated. Under extreme conditions, it may *approach* a gray property. Here is visual *adaptation*. The removal of the fixated object from the field of vision will now permit the opposing physiological function to come unhampered to its peak. The complementary after-image or object may then be observed — the complementary color property appears.

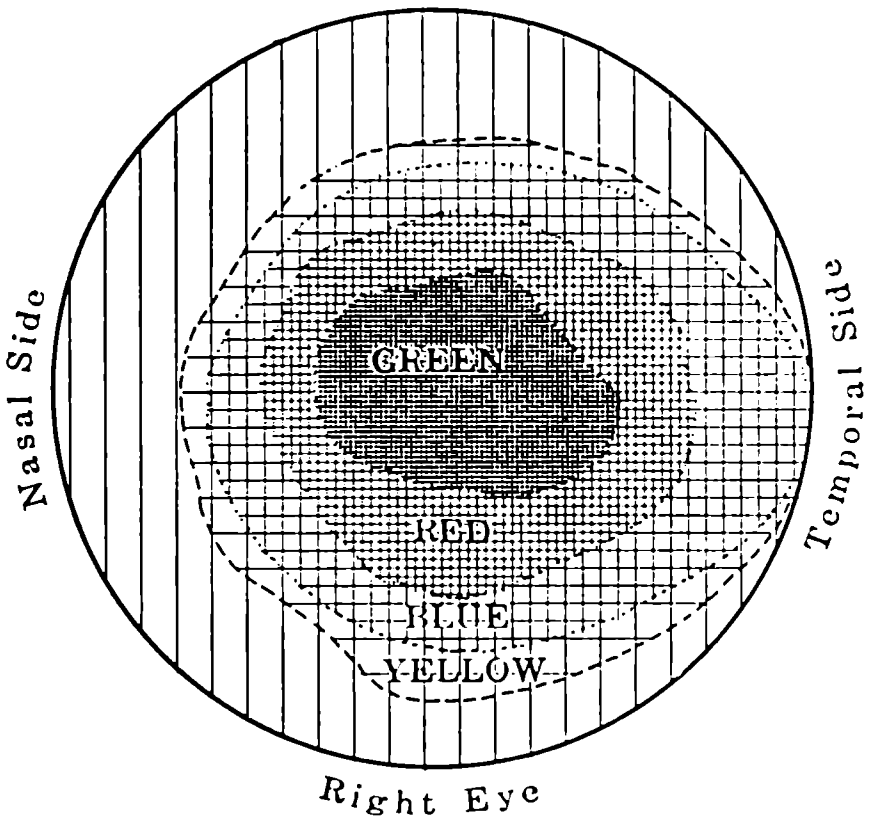

FIG. 23. A diagrammatical outline representing some differences in retinal functions.

d. Peripheral Vision and Purkinje Effect. The gradual disappearance of a color property or the change in the saturation of an object which is slowly moved from foveal vision outward toward peripheral vision is explained partly by the decrease in the total number of cones in the periphery and partly by the *increasing amount* of physical energy actually required to bring the retina to the functional level necessary in order for this particular color property to be observed. To make this clear, let us assume that the *degree* of physical energy required for an individual to perceive a *blue* or a *green* object through the *fovea* is represented by 1. At 40° out toward the periphery (see Fig. 23), the energy thrown off by the same environmental object or source must be about 4 times greater in order for the same individual to perceive the same *blue* object and about 10 times greater in order for him to perceive the *green* object. Again, in order for him to be able to see a red object through the *fovea*, the energy of the illumination must also be 4 times greater than that required for either blue or green properties. And, for him to perceive a yellow object, the

physical energy must be 2 times greater than for the perception of green or blue.

At 40° out, to perceive a *red* object, the energy must be 4 times greater than that required to see a *green* object at the same place. Now, such facts as these which clearly point to differences in the mode of functioning of the *same region of the retina* also make the Purkinje changes more understandable. A given amount of physical energy is not equally effective for the production of all color properties. Physical energy is not always "stimulating." When the light energy slowly decreases, as at dusk, blue or green objects when viewed in foveal vision are thereby actually seen more easily than are either red or yellow objects. The former, therefore, stand out in a more striking manner with respect to two properties than do the latter. They are more saturated and brighter. After all hue properties have completely disappeared, various environmental objects may still be perceived, of course, but they show only varying degrees of grayness. There has been a change in the physiological functions. Theoretically speaking, the rods are now working. Under these particular physical and physiological conditions, the spectrum, for example, may still be perceived, but it now appears only as a band of *unlike grays* in which the brightest region falls around the place of the green and blue properties as observed by a *normal* sighted individual under daylight illumination.

D. *Vision as Affected by Psychological Factors*

In this brief manner we have indicated a few of the more outstanding physical, chemical, and physiological aspects of color perception. This description is only partially adequate because the various color properties of man's objects are also dependent upon certain psychological factors. An adult human being does not always continue to perceive an object in the same manner as he did in the very beginning. His personal history plays an important part in his seeing. Titchener, for instance, has remarked in this connection that things look very different to us because we paint them over, so to speak, with memory-colors, colors that represent their natural or average appearance at the center of the visual field; indeed, we may *paint these colors over the whole landscape, and in that way correct the changes due to contrast or adaptation.* We always talk of a certain book as brown; we recognize

it in all lights, and in all states of the eye, by its *brown* color; we *see* it, in memory-color, as brown, whereas, if that same brown were shown us in all the different circumstances without our knowing it to be the same, it might "look to be yellow or pale brown, or deep brown, or black." Furthermore, we see "snow as white, and gold as yellow, and coal as black, just because they are ordinarily or typically white and yellow and black."

It would seem, therefore, that once a *total object-meaning* (book, coal) arises, that is, once a thing is classified, some one particular property may possibly change without affecting other properties. The shape, size, or color may thus change, within certain limits, without significantly changing the class meaning of the object which is seen. Moreover, many changes may actually occur, physically speaking, in an object which are psychologically non-effective. After he has been removed from a particular object (situation) for some time, an individual may again observe its different properties. Many persons are quite often surprised at the various changes which apparently occur in their friends or in familiar objects during a short absence from them. Their bases may have existed, however, in a physical form for some time. But a psychological change — absence — was necessary in order for them to be perceived.[1]

[1] See Braly, K., "Influence of Past Experience in Visual Perception. *Jour. Exper. Psychol.*, *27*. Also Howell, T., "Heredity as a Differential Element in Behavior." *Univ. Colo. Stud.*, *20*.

OUTLINE

CHAPTER VI. VISUAL PROPERTIES OF SIZE, SHAPE, DISTANCE, AND MOVEMENT

A. Spatial Properties
- a. Size
- b. Shape
- c. The Properties of Size and Shape Are Relatively Independent of the Retinal Image
- d. Size and Shape Are Functional Products
  - 1. Such Properties May Be Observed in the Laboratory in the Absence of a Specific Stimulus
  - 2. Such Properties May Be Described and Measured
- Distance and Depth
  - 1. Distance Perception at Subhuman Level
    - (a) Time of appearance
    - (b) Either inference or observation
  - The Lens
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  - 3. Determining Conditions of the Property of Distance
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  - 9. Retinal Disparity and Stereoscopic Vision
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  - 10. The Problem of Convergence
    - (a) Meaning vs. meaningless sensations
    - (b) The position of Titchener and others
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B. Movement as a Psychological Property of Objects
- a. A Dynamic Property
- b. The Motion Picture
  - 1. The Physical Basis
  - 2. The Psychological Basis
- Some Conditions of Visual Movement with Physically Stationary Objects
  - 1. Space, Time, Intensity
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- e. The Rôle of the Retina
- f. Racial Heritage
- g. The Gestalt Approach
- h. Movement Is Wholly Relative

CHAPTER VI

VISUAL PROPERTIES OF SIZE, SHAPE, DISTANCE, AND MOVEMENT

A. *Spatial Properties*

Through the use of visual perception, an individual from moment to moment also orders and characterizes in terms of their spatial properties the many objects of his environment. He observes an object as having a certain *size* and *shape*, and also as being located at a certain *distance* from him.

a. Size. Perceived size, then, is a psychological property of a human or non-human object. It is a significant functional product of man: it is something that a human being observes in an object. It is one type or form of meaning.[1] It may be the only kind of meaning. Where observation is fleeting and the instruction is strong to observe *size*, an individual may be completely unable to report upon any other characteristic, such as color. It is closely related, moreover, to the perceived distance of an object. One simple method of studying the dependence of size upon the distance at which a thing is seen is used in the laboratory. The apparatus is outlined in Fig. 24. An observer looks at a small colored square upon a screen before him at *S*. After he has stared steadily at this square object, the screen is dropped and the subject looks in turn at *A*, *B*, *C*, or *D*. In this case, the spatial limits of the *physiological* image of the square object formed on the retina as a result in part of the *stimulus* (that is, the sensory conditions of vision) *remain very definitely fixed*, but the actual size of the object perceived at *A*, *B*, *C*, or *D* varies with the distance of the background from the observer. A mathematical statement can be formulated here

[1] Pillsbury points out that every object possesses extent and that "extent seems to belong to the object rather than to sensations as such." Woodworth points out the individual can directly see the distance and spatial relations of objects. A chick reacts correctly to distance as soon as hatched. See also Gellerman, L., "Form Discrimination in Two-Year-Old Children." *Jour. Genet. Psychol.*, *42*.

concerning the dependence of the size of the perceived object upon its distance from the observer.

b. Shape. When the screen is turned, as shown at *D*, at an angle of 45° to the line of vision, the object is then perceived to have a shape which is different from what it has at *A*, *B*, or *C* positions. The retinal image in each of these four cases, as determined by the pattern of physical energy, is the same — a square — but the shape of the object actually seen by the observer at *D* is

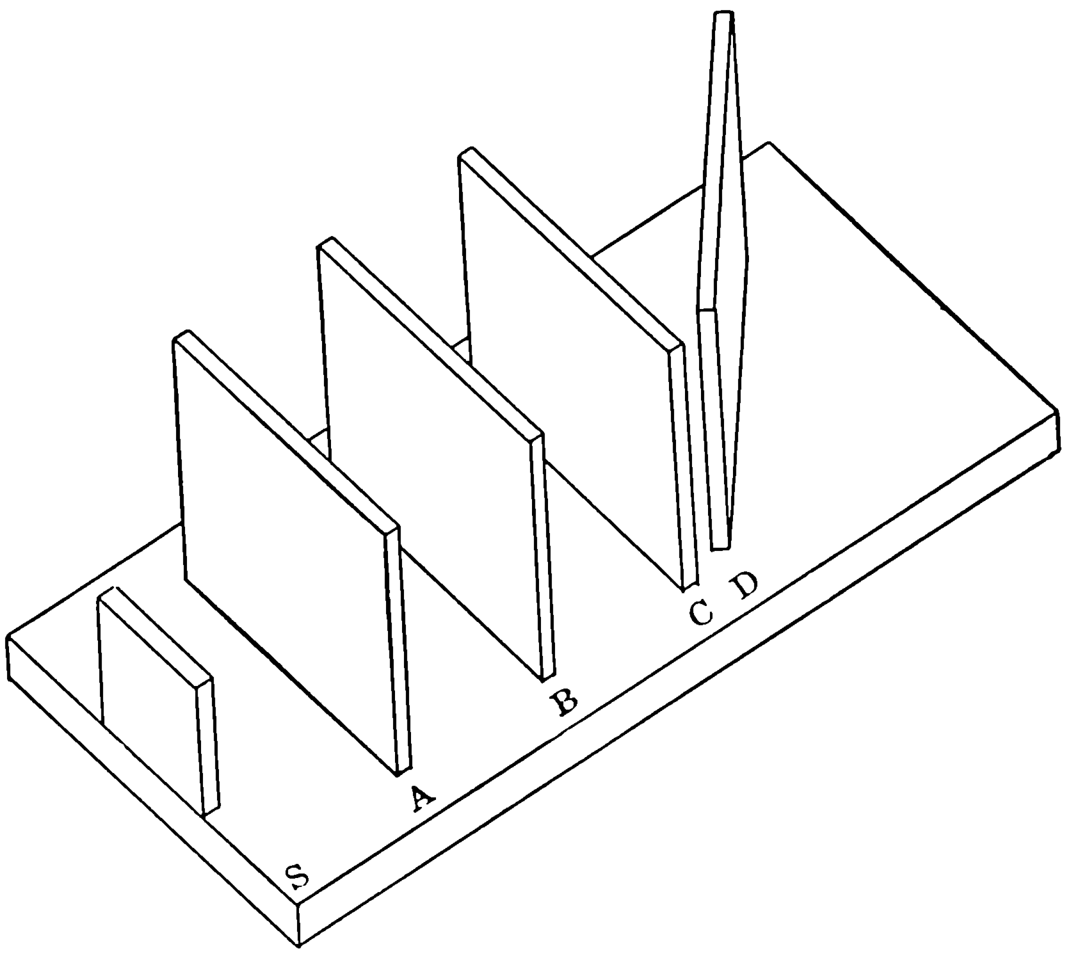

FIG. 24. Apparatus used in studying size and shape as dependent on distance from observer.

trapezoidal. While the stimulus conditions may be partly alike as in these cases, the properties of the perceived object are different. The student will understand from the nature of these results that a very significant difference between (1) the physiology of the eye or of the retina itself and (2) the psychology of seeing which is dependent upon the integrated functioning of the nervous system is definitely implied here. Shape, in case of the object seen at *D*, depends in part upon the perceived nearness or farness of the object as it is related to its background. The properties of size and shape are thus closely related. Normally we do not observe the ordinary environmental object as showing such differences in shape under unlike conditions. We fail to do so because the total object-meaning (the whole) may actually dominate each individual property. When one regards an automobile from a position near

the front, the shape of the retinal image must obviously be quite different from that which exists when the car is perceived from a position some distance to the rear. Yet in both case, however, the size and shape properties remain much the same. Under laboratory conditions, the individual is more naïve. The properties of the perceived object are less dominated by a total object, or class, meaning. The student can easily confirm the influence that the class meaning of an object has upon his perceiving. As he observes an object (man) move away from him, he will find that it *retains* its size relations to a striking degree. But it is quite different when he observes a *strange* object; he will immediately recognize that it is necessary to place some *known* object with it in order that its "comparative size" may be perceived.

c. The Properties of Size and Shape Are Relatively Independent of the Retinal Image. Many students who have not studied psychology seem to believe that the visually perceived size and shape of an object depend *directly* upon the physical size and shape of the retinal image.[1] But it should be clearly understood that the observed characteristics of all other objects within the total visual *field* generally have great significance for vision. The organism, of which the retina is only a part, normally functions as a whole.

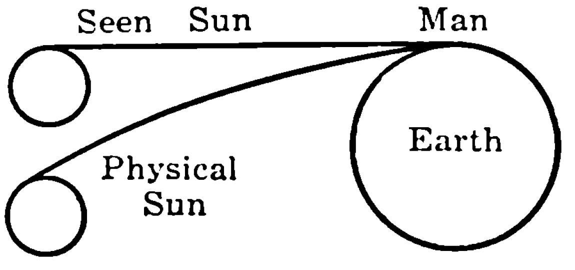

FIG. 25. When does the sun set?

There is accordingly far more to visual perception than one can possibly gather from a study of retinal functions. Because the organism — not the retina — normally observes total situations, the psychological properties of any visual object are dependent in part upon the properties of the other objects which accompany it.[2]

[1] In this connection let us recognize that the retinal image of the sun at the horizon is no larger than that of the sun in the zenith, but the perceived size is different. We should like to point out, too, that the sun "sets" physically before it does psychologically. Figure 25 shows how the light rays are bent by the atmosphere so that we may still see the sun after it has sunk below the horizon. We actually perceive it where, physically speaking, it is not; that is, we simply project it into space. The stimulus energy may curve, but psychological projection in such cases is straight.

[2] It should be understood that we refer by "total situation" to psychology and not to physics. We do not mean that one perceives the total physical situation. No one ever does that. One person may actually see very little in a situation, where another sees much. Yet in both cases a total situation is always perceived. We assume that whatever thing is perceived by an individual must be in, around, or on him.

A simple illustration should clear this point. It is well known that the presence of one object in the visual field obviously affects another object beside it. The visually perceived height of a person definitely changes with a change in the height of his associates. Placed beside a short individual, a tall man becomes taller. A large hat, for example, will "do things" to a human face that a small hat cannot possibly do. This kind of dependence of the property of one object upon the property of another is also strikingly shown in many of the *so-called illusory experiences*, some of which we shall later describe.

d. Size and Shape Are Functional Products. An interesting point arises in connection with the method described above (Fig. 24). If properly considered, it will materially aid the student in understanding more clearly the psychology of perceiving. He will readily realize that, when he looks at *A*, *B*, *C*, or *D*, there is *nothing at any time which passes from his eyes to the background* to cause him, independently of other factors, to see these objects. And he will also understand that there again is *nothing of a physical nature which passes from the background to his eyes to cause him to see* these objects.[1] But he can observe certain properties of an *object* there; another person can assist him in its measurement by means of a scale; and its size, shape, and color can be drawn or minutely described. The object is before the individual on the card. It exists, we say, as a direct result of the intimate relations between a total organism and its environment. It is, in short, the *end-stage* of one kind of functional activity. It cannot be physically torn away from the background, nor can it be handled as one might a piece of coal. But its color may be the color of any

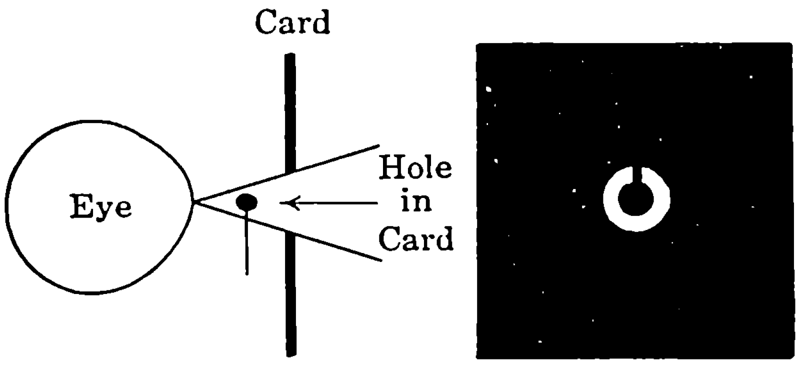

Fig. 26. What is the stimulus, the background, and the observed object?

[1] A very simple but striking demonstration of psychological projection where there is, as usual, a background, a stimulus object, and a human organism may be made in this manner (see Fig. 26). Pierce a card with a pin, and then hold the pin, with its head up, closely before the eye. Then bring the card up a few inches from the pin, and in such a way that the hole and the pin lie on a level with vision. In this case, the observer will perceive a pin at the hole. And it will stay there as long as he observes under these conditions. Let him also observe with three holes punched quite closely together.

ordinary object daily perceived in the environment of the individual. Moreover, the physical situation is not in any way peculiar or strange. The individual is stimulated and he *sees* an object. An understanding of the results of this experiment should materially aid the student in understanding those very striking cases of hallucination and delusion which he often encounters in his study of psychological diseases and disturbances. To deny that such *seen* objects exist is to deny the existence of a part of life. They are, in short, the actual resultant of a total set of *causal* conditions. Under such particular conditions, *nothing else can possibly exist.* If one wishes, however, to deny causation, the problem assumes a different aspect.

e. Distance or Depth. Size and shape are psychological properties of visual objects. Distance is also a property. In each case, there is no *specific stimulus in the form* of some particular kind of physical energy, and there is no meaningless sensation of depth, size, or shape. Titchener (p. 126), for instance, says that "we seem, quite immediately and directly, to *see* distance." We say that we do not *seem*, but that we actually *do* see distance. The perception of distance is in part inherently determined. We also assume that the way in which an individual has functioned in his personal past directly affects or determines in part the nature or character of what he observes at any moment. The personal past of an individual operates among other ways by determining what aspects he intends to see, what objects he hopes to see, or what objects he must see. He unquestionably learns, for example, to *disregard* certain psychological properties and to *emphasize* other properties of things. That he succeeds fairly well, every student must surely know. If he does not, let him consider solely the difference in what he observes when he is in a strange, dangerous place and when in a familiar, harmless place. Of this sort of determination, we shall later speak in detail.

1. *Distance Perception at Subhuman Level.* We recognize that evidence by analogy from animal to man is not always reliable. But we wish to point out that many kinds of animals seemingly possess, without any prolonged period of training, a very high degree of perceptual ability as far as distance seeing is concerned. The taking of food and prey on the wing by whippoorwills and falcons; the location of carrion by vultures from great altitudes;

the hunting hawk hovering over a tiny mouse in a weed field; the homing behavior of pigeons; the spider leaping several inches upon its prey; the turtle plunging from its laboratory support, — all these instances apparently point in the same direction: Space perception among subhuman organisms is apparently not a matter of slow and gradual acquisition through some form of trial and error learning. If animals do learn much in this respect, they learn at an astounding rate.[1] The writer secured some experimental results in this connection from a study upon white rats. Eight rats were reared from birth in a cylindrical container with a small hole in the top to permit ventilation, normal illumination, and feeding. At the age of three weeks, they were removed and placed on a wire screen $1\frac{1}{2}$ feet by $1\frac{1}{2}$ feet at a distance of 16 inches from the floor. With them were also placed seven other rats which had just reached the stage where their eyes were opening. Both sets of rats thus saw the world for the first time from the top of this support. These two litters were tested over a period of two weeks, during which time they spent a total of 24 one-hour periods on the wire screen. During this time, two of these young animals jumped or were crowded by others from the support. The other animals repeatedly explored at the edge of the screen and appeared to be looking over. But they did not jump.

Moreover, such behavior as falling, reaching, and walking in young children does *not* seem to indicate that their environmental objects are lacking in distance meaning until they have possibly learned about their distance either by walking to them or by being told about them.[2] Furthermore, we must recognize that where they are properly instructed, adult individuals who perceive visual objects under experimental conditions of instantaneous exposure may see their *distance* just as quickly and as immediately as they do their *size and shape* properties. It would seem quite impossible that any *inference* from combinations of kinaesthetic sensations could in any way account for the visual properties perceived under

[1] Let us be clear. The emphasis here is more upon maturation (and less upon learning) for the very simple reason that we have no experimental basis for assuming that animals learn rapidly enough to account for the high degree of excellence so early shown in their lives in connection with visual perception.

[2] In this connection, Pillsbury points out that estimates in terms of movement alone are more inaccurate than those in terms of vision alone. We have no accurate idea of distance walked through in the dark. And the visual estimate of distance is more accurate than the purely motor estimate (22, 227).

such short periods of exposure.[1] We find no reason whatsoever for assuming any *inference* from sensations to produce distance perception at the animal level.[2] Furthermore, the muscles of the human eyes do not work either rapidly enough or in such different ways as to explain adequately these experiences. We are accordingly forced to reject the claims that the muscles of the eye which control the movements of the whole eye, as well as the lens, determine the perception of distance. Let us examine some facts in this connection.

2. *The Lens and Distance.* The lens indirectly serves in a wholly mechanical manner to produce perceptions of the *shape* of objects. The lens itself (see Fig. 22) is a wholly non-sensitive, regulatory structure. In some way, as yet unknown, it coöperates to a remarkable degree with the retina in keeping the light waves from a source of energy sharply focused upon the retina. Where the lens fails to function effectively, objects at certain distances become blurred — "fuzzy." They lose their sharp outlines. When a cataract, for instance, develops, the lens may become completely filled with a white or yellowish substance. This obstacle to *clear*, sharp vision may be surgically remedied by slitting the eye and by pulling the whole lens out. But the visual perception of distance is not thereby destroyed. Changes, however, do occur in this respect. The removal of the lens usually produces a change in vision of slightly over 10 diopters. When the student realizes that from the ages of 40 to 70 years, an increase of about 2 diopters normally occurs, he can better understand why the perception of the shape of objects following a cataract operation may not be very good. Corrective *bifocal* glasses may at times be used by an individual, but they can assist him in seeing the shape and size of objects in full clarity at only two positions — near and far. His eyes (with glasses) may be compared for purpose of understanding with a *camera* which is so fixed that it can take a sharply outlined (clear) photograph of some object at *only two positions.* Fuchs, for example, points out in his discussion of the diseases of the human eye that *when an adult is operated on* for cataract, we must "warn him that in general the vision in the eye operated on

[1] Perception of depth may be obtained in a slight fraction of a second. The method of illumination by the electric spark has been used. Under these conditions distance may be perceived in a flash.

[2] See chapter on "Discrimination" (in *Comparative Psychology*) by Fields.

will be very different from that of the other (good eye), and usually quite blurred; and that it will be difficult or impossible for him to correct his eye fully with glasses on account of the removal of the lens" (p. 644). In general we can say, that as long as vision is blurred, all visual properties will be more or less affected. This is more true of some than of others.

3. *Determining Conditions of the Property of Distance.* The property of distance depends upon the character of the integration among several possible determining factors. Just as we cannot speak accurately of the color property of an environmental object without definitely assuming, or specifying, certain conditions of observation, so we cannot speak of the size, the shape, or the distance of an object without stating the various conditions under which the particular property is produced or observed. The distance of an object, strictly speaking, is not its height, its color, nor its movement. Yet the property of distance is no more *completely* independent of these than the color property of an object, as we have said, is absolutely independent of its distance. Every object usually shows several unlike properties. These properties may be interrelated. That is, since they are to be regarded as really *being* some particular object, in the sense that an object can be *known* only in terms of its properties, a certain degree of relationship commonly occurs among them. The degree of dependability and changeability in the perception of distance is no greater than that which characterizes the perception of color. Among the several determining factors in the production of the distance meaning of an object which we shall consider here are those of movement, height, size, color, haziness, superposition, shadows, and disparate images (retinal disparity). All of these, it should be understood, are psychological. We shall discuss each as though "all others were equal."

4. *Distance Perception through Movement, Height, and Size.* An airplane that is seen moving slowly through the sky is also perceived as being far away. The same is true of a train, a car, or an animal seen on plain or mountain. Again, the perceived motion of the objects around an observer who is himself on a moving object determines their distance. The more distant objects are seen to move more slowly than the objects which are near. Moreover, a glance at a row of receding trees or pillars is sufficient to show the part that height plays in distance perception. The

taller are seen to be nearer; the shorter are perceived to be farther away.[1] This common psychological device is widely employed by the landscape artist to portray differences among his pictorial objects in terms of their distance. He draws distant objects as being shorter, and he also places some objects lower than others on his canvas so that they may be immediately perceived as being nearer the observer. Furthermore, an individual perceives the distance of an object in terms of its size. A train or car, toy-like in size, is seen as being far away. A speck on the window glass may momentarily be seen as some very distant object, such as an airplane. We do not suggest, however, in such cases, that an individual first observes the size of the object and then imagines or infers its distance. The distance of an object *in such cases* is perceived as directly and as non-inferentially as its size is. We must also point out, lest the student err in his thinking, that by distance we do not mean some determined *physical* distance. By distance we refer to what is *seen*. Physically speaking, there is distance such as a light wave might travel during one second. It might also be the length of a unit — a foot or a yard. Psychologically speaking, distance is that property of an object that depends directly upon an observing organism. If we were, for instance, to ask two great physicists to measure ten different times the distances between two objects, their distances would not be identical.

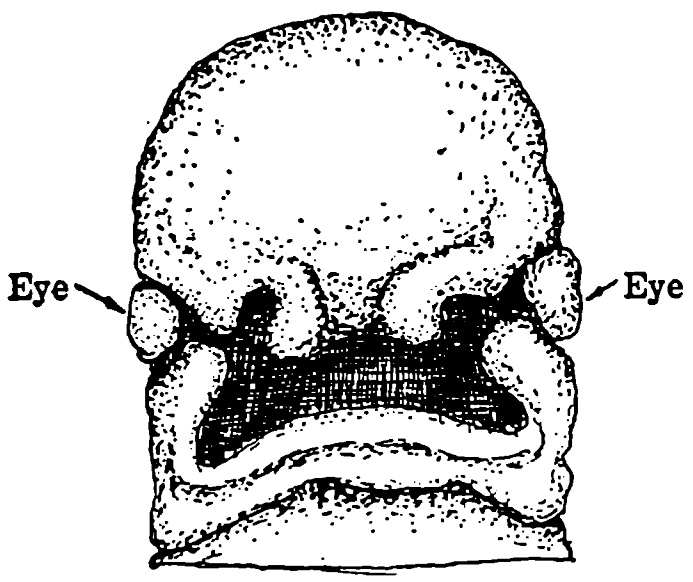

FIG. 27. Location of eyes in human embryo. Ocular migration subsequently occurs.

5. *Through Color and Haziness.* The distance of a mountain range, or of a headland when the latter is viewed from the sea, is also dependent in part upon its color properties. The bluer the object appears, the farther away it is seen to be. The degree of haziness or dimness of outline of an object also affects in part the property of distance. The artist makes valuable use of this relationship. If he wishes certain objects on his canvas to be

[1] One could also say that because some are perceived to be nearer, they are also seen as being taller; while others, perceived to be farther away, are seen as being shorter.

perceived as being nearer than others, he sharpens their outlines. Perceptually — psychologically — speaking, a headland may be moved a considerable distance either toward or away from an observer solely through a decrease or an increase in the degree of atmosphere haziness.[1] The student may possibly discover for himself the nature of the several changes which normally occur in the size and the distance characteristics of environmental objects when the latter are viewed in a fog. Under these conditions, old familiar objects actually assume new properties (dimensions).

6. *Through Interposition and Shading.* We may perceive one object as being at a greater distance than another, when the former is partly obscured or covered by the latter. Interposition or

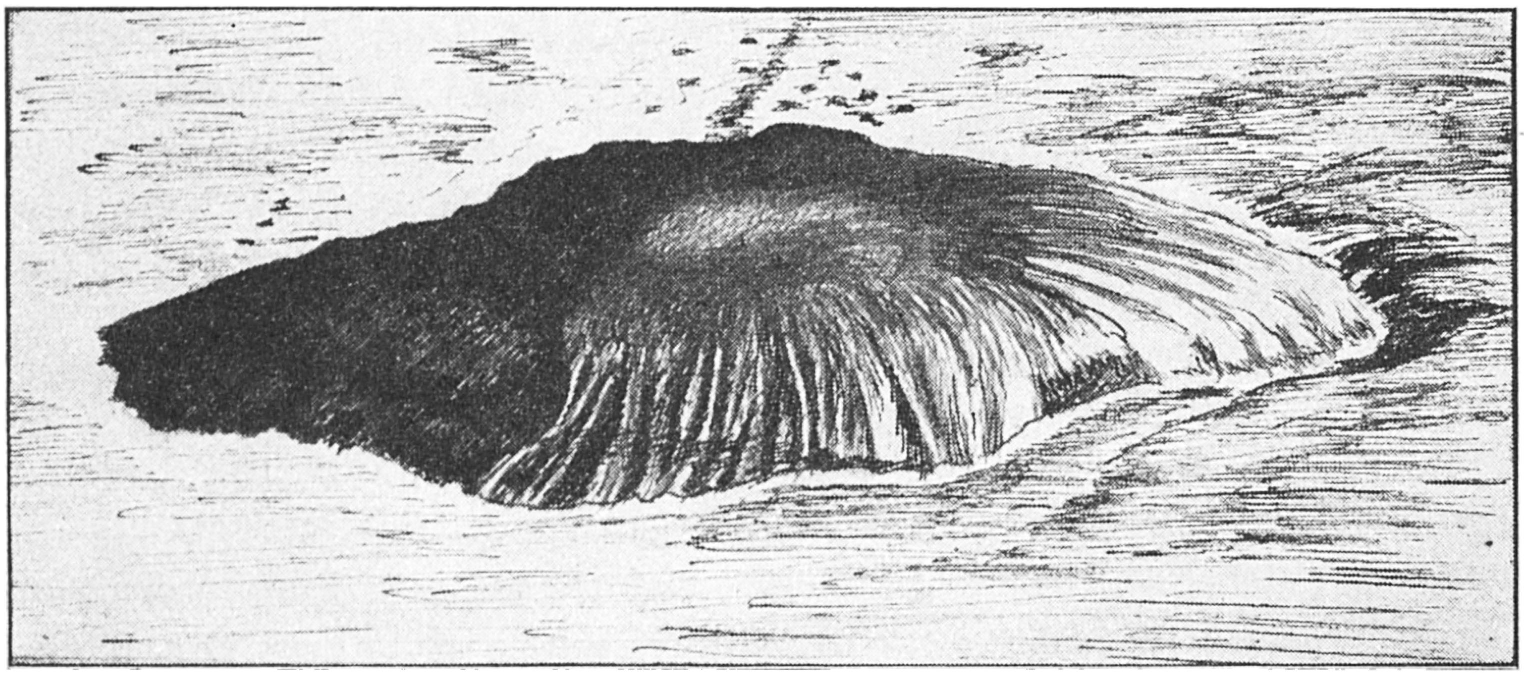

FIG. 28. A hill in South Dakota; a hole in Arizona (turn page around).

superposition is used very widely in the visual perceptions of the average individual. It is also a common method employed by the artist to produce, on flat surfaces, the desired perceptible differences in the distances of pictured objects. Another very common psychological characteristic of an object that may affect its spatial relations is its pattern or distribution of light and dark areas — commonly called shading. We recognize accordingly the wide use made of such tint differences in giving body and substance to advertisements on billboards and in magazines. An object on a flat surface may be made either to stretch away from or to extend toward the observer, or to take on body to a striking degree by the use of shading (see Fig. 28). The nature of the visual stimulus, in such cases, may remain quite unchanged.

[1] Bentley points out that the clarity in the object directly affects its distance quite without memorial revival or associative aid. "The hazy mountain immediately looks far away; the clear-cut mountain relatively near at hand" (p. 228).

7. *The Rôle of Monocular Vision.* Because of these several characteristics of an object, its distance (depth) may be perceived by an individual who has but one functioning eye. As a matter of fact, the loss of one eye may have surprisingly little effect upon an individual's perceptions of spatial properties. We could cite much evidence in support of this statement.[1] The writer wishes to mention the following case. His father suddenly discovered that he was not quite as accurate as he had formerly been in work involving such actions as pouring fluids into test-tubes; moreover, he found that he had difficulty in getting a match exactly over the bowl of his pipe. It would be a fraction of an inch in one direction or another. The reason was not apparent for a period of almost three weeks. It came quite suddenly. One day a drop of liquid struck one of his eyes. He closed it, and found himself to be wholly blind in the other eye. Experimental evidence indicates that an ordinary thread, viewed monocularly at a distance of about three feet, must be moved two inches to cause any change to be perceived. Viewed with the two eyes, the thread must be moved slightly less than *one* inch in order for a change to be observed.

8. *The Rôle of Binocular Vision.* The use of the two eyes in vision is not primarily concerned with the color properties of a perceived object. They do, however, contribute in a particular way to an individual's perception of distance, depth, or third dimension. Since the two eyes focus upon an object from unlike angles, *two different perceptions* of the object are obtainable; that is, two are possible if the observer will perceive first with one eye and then with the other (see Fig. 29). When both his eyes are fixated simultaneously upon an object, a *single* object — one view — is normally perceived which possesses distance, depth, or third dimension. But we do not mean to imply that when the object is viewed with one eye only it is lacking in such spatial properties. As we have said, that would mean a one-to-one relationship exists between this spatial property and binocular vision. Many species of animals have "one-eye" vision. The duck is an example. Here, as well as in the human embryo (see Fig. 27), the eyes are placed relatively far back on either side of the head. In the human

[1] In this connection, it is interesting to note that Fuchs states that binocular vision is not important in fine work like writing. Even the watch-maker, he says, "who does the most minute work does not require binocular vision" (*Ophthalmology*, p. 822).

beings, the eyes gradually move around to the front, thereby permitting full binocular vision. Every psychological property apparently appears as *one phase* of a total situation in which several unlike factors are involved. One of these factors is the use made by the human organism of its two eyes in securing a single *view* of an object from two different angles. Under certain conditions, this gives rise, in a striking manner, to a single psychological property.

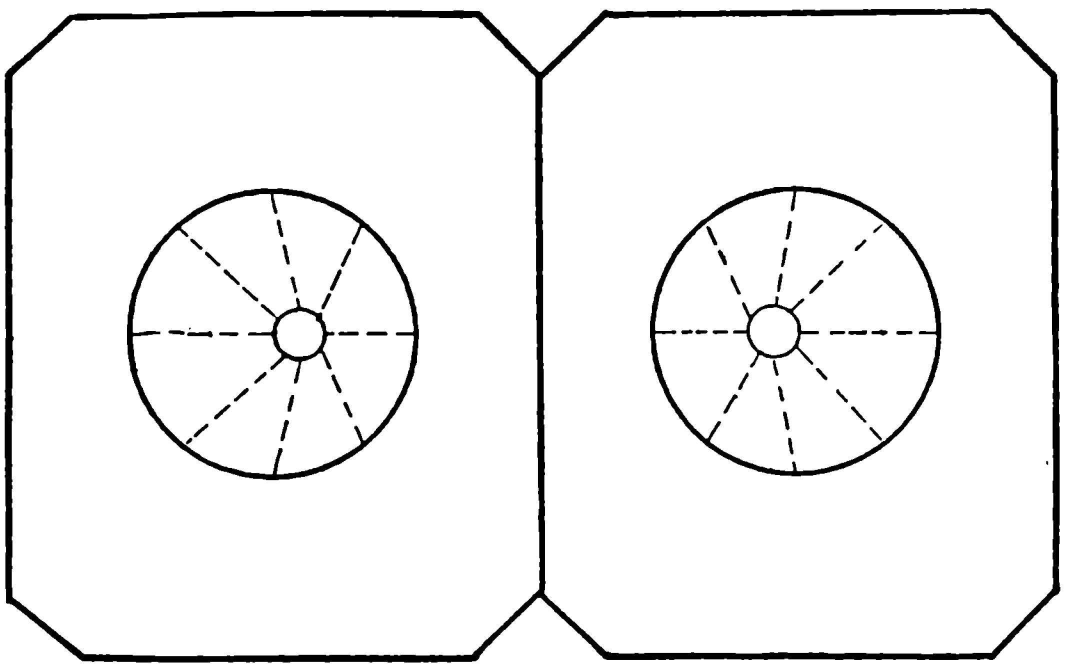

FIG. 29. Stare steadily through and beyond and observe properties of new object.

9. *Retinal Disparity and Stereoscopic Vision.* The significance of binocular vision (retinal disparity or different views) may be very clearly demonstrated by means of the ordinary stereoscope (see Fig. 30). Two pictures of an object or situation which have been taken from two slightly different angles may be so presented to the organism in a stereoscope as to be perceived respectively by the two eyes. To use a rough illustration, it is as if the two eyes of a human being had been taken in some magical way to the place of the photographed scene. The visual property that arises when two flat pictures are observed in this manner is both striking and well known. The significance of the general principles involved in the stereoscope can be more fully understood if the student will look with one eye at either of the stereoscopic objects. He will perceive depth, it is true, but not of the same nature or to the same degree that he does when his two eyes work together. It is quite evident, therefore, that the organism in the case of stereoscopic vision actually "creates a psychological property by using the two eyes instead of one," and observes it to be a characteristic of the perceived object. In all such experiences, it must be recognized,

there is unquestionably a very decided departure from the *physical properties* of the visual field, as the latter is commonly regarded by the student. Physically speaking, the field (pictures) in these cases is quite flat; but psychologically speaking, it is definitely contoured.

The stereoscope is not a psychological toy. The student should realize that the stereoscope must not be regarded as being merely a psychological toy, plaything, or demonstration apparatus. On the contrary, it is a standard instrument used at times by physicians in the treatment of certain functional troubles in vision. A much finer apparatus, however, than the one shown in Fig. 30 is commonly used. Let us see how it is employed. Every individual has probably discovered, for instance, that one of his eyes normally dominates the other. Or, he can readily discover this visual dominance in his own case by looking at some small object a few feet from him through a circle formed from his finger and thumb. In this way he localizes the object through the circle. If he will then alternately close his eyes, he will find that he sees the object through the circle with one — the dominant — eye. But through the other — non-dominant — eye he will see the object as falling outside the circle. He must now move his hand in order to see the object through the circle with his non-dominant eye. If the student will repeat his observations here a few times, he will be sure to have discovered whether he is "right-eyed" or "left-eyed." As the eyes move from object to object, the dominant one is assumed to lead the way while the non-dominant quickly follows. Generally speaking, the cross-eyed person has one extremely non-dominant eye. In a few cases, either eye may be non-dominant. Under such conditions, either eye may be crossed. When one is, the other is dominant. Eye dominance is established in about 80 per cent of individuals by the end of their third year of age. In almost every case it comes before school age.[1] Approximately 3 per cent may show ambiguous dominance for many years or throughout life. In all cases, the individual neither knowingly

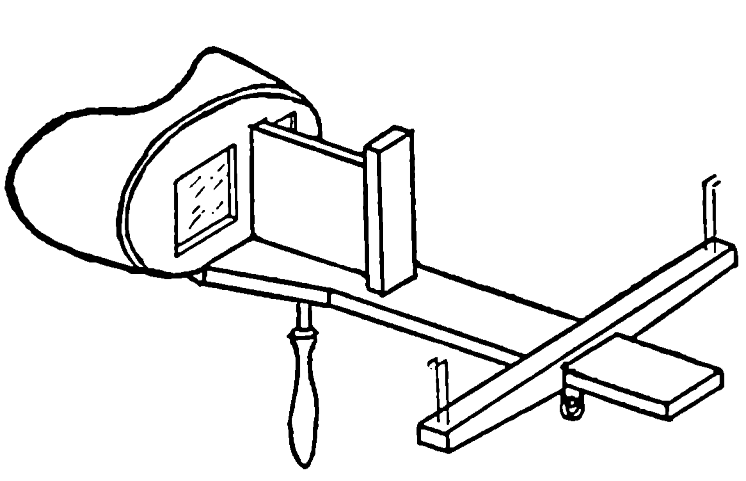

Fig. 30. A form of this apparatus is used in cases of strabismus.

[1] Generally speaking, seven out of ten school children show right-eye dominance.

develops nor learns this dominance. It is a product of his development.

In the case of an adult human being who, from birth, has had strabismus in one eye, no use whatsoever of this non-dominant eye is made in seeing. If an adult should suddenly become strabismic, he will tend in most cases to see everything for a short time as being doubled. In a surprisingly short time, however, the turned eye absolutely ceases to function. In the individual who is born with strabismus, or who develops it shortly after birth, only one eye functions as long as strabismus remains. It should be clearly understood that there may be *nothing structurally wrong*, in the least degree, with the *retina* of the turned eye; but it is dominated by the good eye. Light rays — stimuli — from possibly thousands of energy sources continually strike this eye, but it simply does not work coöperatively in perceiving. As far as such use is concerned, it simply is not there. Yet, physiologically speaking, the retina apparently works because it does not deteriorate as it would if it were physiologically inactive. It works, but with no psychological resultant. Now, if this cross-eye is straightened by operation during the *adult* years, it apparently *continues as in the past.* It simply does not coöperate in seeing; vision is still monocular. The eye is structurally sound, but it does not see. The trouble is purely functional.

The stereoscope is used in cases of cross-eye to train in binocular vision, that is, to "educate" the individual in the seeing of depth with his two eyes. When this training is started very early, such an eye may possibly be brought to perfect coöperative vision.[1] By use of the stereoscope, by bandaging, or by putting drugs in the dominant eye, it is actually possible in *young children* to exercise the non-dominant eye sufficiently to place it upon a coöperative functional basis with the dominant eye. Where such a condition exists in both eyes, training may possibly be easier in some cases because it means that either eye may, at times, dominate. The functioning of the one eye under these conditions is not so completely submerged by the other.

10. *The Problem of Convergence.* Some students have sought to find great significance for the perception of distance in connection with the *convergence* of the two eyes. It is recognized that the two eyes normally turn toward each other as a visually fixated

[1] Schweintz, G., *Diseases of the Eye*, p. 571.

object approaches the observer. Under certain conditions ocular convergence seemingly serves as a determining factor in visual perception. This holds true for relatively short distances. But the eyes and the brain function intimately in these cases. It is unnecessary to assume intermediate mental agents such as kinaesthetic sensations [1] aroused by the movements of the eyes as they turn in or out. Such sensations are themselves utterly *lacking* in distance property. Moreover, being sensations, they are unobservable. Although they are completely meaningless and unobservable, they are assumed, nevertheless to *combine* in some way to produce the perception of an object as being at a certain distance from the observer.

This represents one sort of explanation. The student may perhaps discover its value for himself by turning to the striking property of distance observed either by means of the stereoscope or in stereoscopic motion pictures. Or, let him turn his eyes in and out while at the same time he regards some object before him on his desk to see whether it changes its distance with respect to himself. Let him also attempt to answer for himself the question, "How much am I helped in this particular experience of seeing the distance of objects by muscular sensations induced through convergence? Starling, for instance, points out that convergence has "little or no effect on the perception of distance." He cites the experimental use of glasses which caused the eyes to *change convergence* from moment to moment. No change occurred in the distance of the perceived objects.[2]

Distance, regarded as a psychological property or characteristic of an object, is as immediately observable [3] and is as elementary as the property of color. It cannot possibly be reduced either (1) to simpler and non-meaningful terms, that is, to purely visual and kinaesthetic sensations, or (2) to memories of past experiences. Some years ago Titchener, who was a most outstanding student of sensation, remarked that "it is difficult to believe that the blend of visual and kinaesthetic sensations should yield a result so

[1] That is, sensations aroused in the muscles of the eyes by convergence, or by moving the lens of the eyes to focus the light waves upon the retinas. In the latter case, we read of the strain sensations of accommodation.

[2] For a different interpretation see Swenson, H., "The Relative Influence of Accommodation and Convergence." *Jour. Gen. Psychol.*, 7.

[3] Third dimension is apparently perceived immediately and can be analyzed into its elements only indirectly (Pillsbury).

different from either, — namely, the perception of space. It seems safer to say the binocular picture, the appearance of a book to the two eyes or the combined image of the stereoscope, carries *the immediate meaning of depth or voluminousness.*[1] The picture is not itself deep or solid; but we cannot help perceiving it *as* deep and solid; and this pressure is laid upon us by what we have called racial heritage, an inherited disposition of the nervous system" (p. 129). Warren and Carmichael, too, after speaking of the significance of sensations and memories in connection with this problem of spatial perception write that "it would be wrong to say that we first see things flat and then correct this impression. The perceptual process is immediate — it is not an inference. We perceive the size and tilt and depth of things at once" (p. 158).

Through his perceptions, man experiences the spatial characteristics of objects.[2] Environmental objects actually possess certain psychological properties because a human being functions in a particular manner under the several conditions which we have mentioned here. These observable object-properties cannot be reduced to simple sensations or simple images. Neither can they be reduced in the slightest degree to the categories of physics and chemistry (see Chapter I). They are, in short, quite irreducible and wholly unique. They can be properly understood only when regarded as being the products of a function which has emerged and evolved.

Considered genetically or historically, such functions assume significance; they are recognized as the fruit of a long development. They have served subhuman as well as human stocks. Because

[1] Starling writes that accommodation (so far as sensations are concerned) has very little, if any, effect upon the perception of depth or distance. (*Human Physiology*, p. 457.) Accommodation usually disappears before 65. But perception suffers no loss at certain distances.

[2] It occasionally appears that some individuals apparently believe, because the eye is curved, thus making the image of a physically straight line curved upon the retina, that men *learn* to see a line as being straight. Likewise, another line is seen to be curved because they have learned that it is so. Yet, interestingly enough, men never learn to see the stick, partly submerged in clear water, as being straight. Moreover, a man may wear a pair of glasses with a slight imperfection in them for a long time without ever overcoming to the least degree the *distortion* of the light waves produced by their imperfection. Furthermore, it is well known that the image on the normal retina is inverted; but there is no evidence that persons operated on for cataract at first see things (or respond to things) as being inverted. We again point out that the inversion of the visual field by wearing lenses is never followed, *as long as the lenses are worn*, by normal vision. That is, objects are not perceived to be right side up.

they furnish the organism with an effective way of dealing with its environmental objects and relations, they may be said to possess great survival value. Strictly speaking, these functional properties of man are, however, no more explicable in final terms *than are the functional properties of water, rubber, or acid.* The student will undoubtedly discover this fact for himself. And, as a result, his comprehension of psychology, as well as other sciences, will thereby be enlarged.

B. *Movement as a Psychological Property of Objects*

a. A Dynamic Property. Among the several possible psychological properties of a perceived object, we must place that of movement. Here, again, we deal with a definitely perceived and outstanding property which repeatedly occurs in the complete

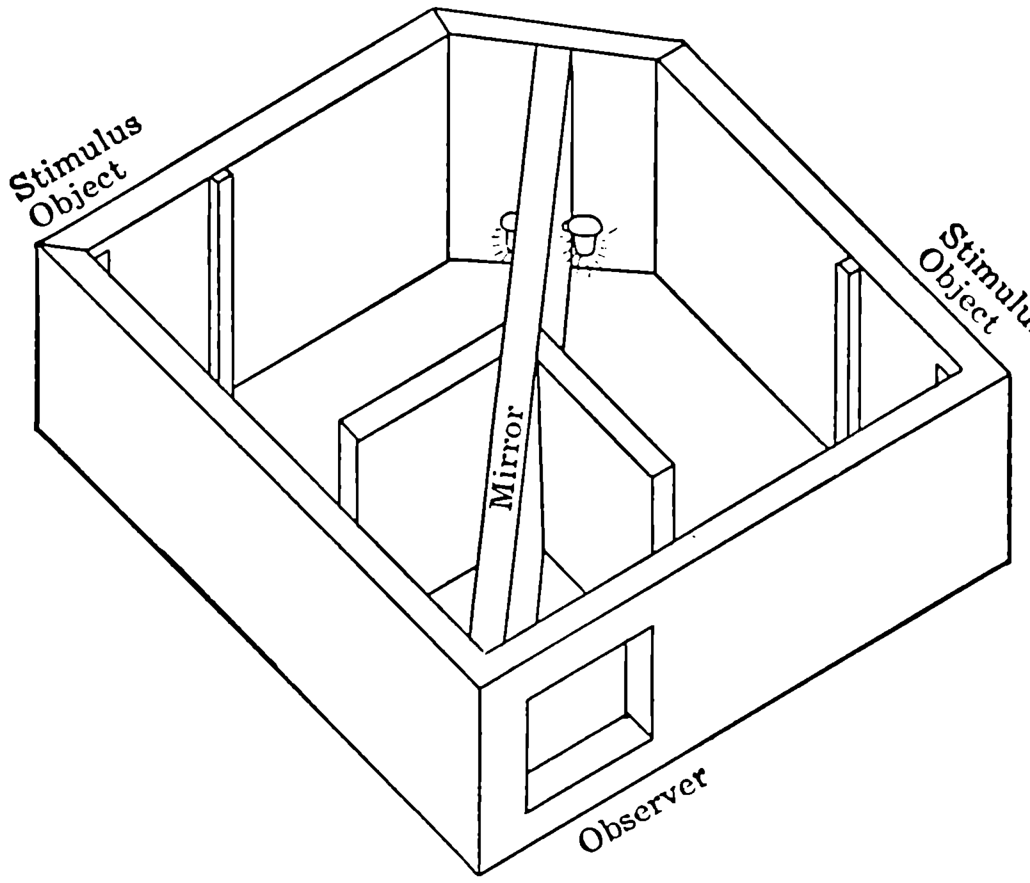

FIG. 31. Mirror tachistoscope. Used in studying visual movement with stationary objects.

absence of any *specific stimulus or of any specific sense-organ* for movement. Because of this fact, various students who are generally inclined to hold to the notion of sensations have been forced to put their descriptions of the observed movement in terms of perception. But we shall regard it in exactly the same manner as we have other properties, *namely*, as being a psychological characteristic of an object which exists solely as a result of the relations sustained between an organism and certain sources of energy. In many cases, of course, the perceived object may,

physically speaking, be in motion; but, in many other cases, the object, physically regarded, is absolutely stationary.

The clear perception of movement, where there is absolutely no motion of a physical nature — describable by a physicist — is a striking psychological phenomenon. It is, moreover, a property of objects which every normal individual has probably observed a great many times. It is something he may have paid to see. Consider, among many other illustrations, the electric sign in which some object turns, runs, pours, or flaps; the world which suddenly shifts and whirls crazily about an individual in a moment of dizziness, or when his eyeball is gently pressed; the moon that hurries so rapidly across a partly cloudy sky, yet travels so slowly; the will-o'-the-wisp that dances erratically over the swamp "to lead the unwary to destruction;" or, finally, the innumerable objects which move night after night over the motion picture screen, yet leave there no physical trace of their passing.

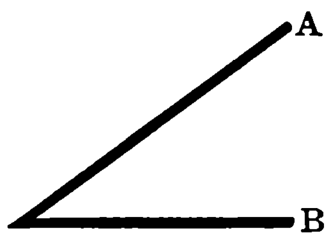

FIG. 32. When presented in succession, a single object moves up and down.

b. The Motion Picture.[1] In the motion picture, movement is so obvious that even very young children, lacking previous training in this particular connection, see it; and savages, totally unacquainted with the motion picture in any form, instantly perceive it. In the moving picture, there is, physically speaking, just a sequence on the screen of motionless scenes — reflection of physical energy — between any two of which the screen is blank. When the projection apparatus is run very slowly, one can secure a better understanding of the nature of some of the physical conditions involved in the phenomenon. When the machine is stopped, a still scene may be perceived. Physically regarded, there is absolute discontinuity between the successive scenes shown on the screen; psychologically regarded, however, there may be striking continuity — for out of this simple physical sequence of *stimulus, no stimulus, stimulus* there issues, in addition to others, a dynamic psychological property. The observer simultaneously perceives many things of different sizes and shapes to be in motion. Under these conditions, the degree of reality of an object and of a situa-

[1] According to Woodworth, motion pictures "afford a striking example of the tendency to see objects and their behavior and not simply *to see the light by which the objects are revealed*" (italics ours).

tion may be so great that naïve savages may be aroused to a fighting pitch and civilized men may weep. This psychological property, like all others, depends upon a total situation involving unlike conditions both outside and inside the organism.

c. Some Conditions of Visual Movement with Physically Stationary Objects. Outside the organism there are the patterns of physical energy presented to the organism at certain *temporal* intervals. These time-intervals themselves play a part. Again, the spatial *separation* between the positions of the perceived objects shown in two successive scenes must not be too great. The *intensity*, too, of the visual objects may serve as a determiner of this property. Large changes in any one of these three physical conditions — time, space, and intensity — result in a total or

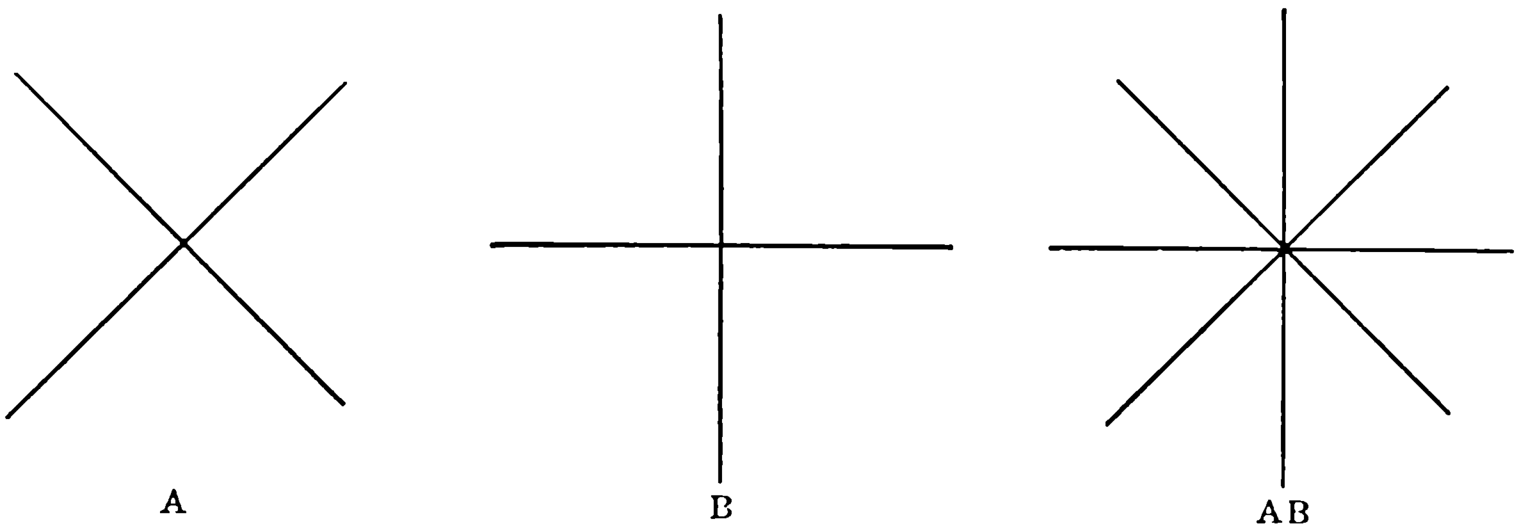

Fig. 33. When *A* and *B* are shown in succession as *AB*, an object is perceived to rotate in either direction. The direction depends upon intention.

partial loss of movement. Inside the organism, there is the functional disposition, established through the individual's history, to see movement. Experimental study has shown the relative significance of these several factors.

If the diagrams shown in Figs. 32 or 33 are presented to an individual in sequence, such factors as (1) the significance of the spatial separation, (2) the time interval between the objects, and (3) the intention (disposition) to see movement in a particular direction, may be carefully studied. Where the intention, for instance, is quite strong, the temporal interval may be reduced to zero, or the spatial separation between the objects may be considerably increased. When the members (*A* and *B*) of Fig. 33 are given in succession (*AB*) by means of some apparatus like that shown in Fig. 31, the observer, upon being properly instructed, can see an object moving in either a clock-wise or counter clock-wise direction. By changing his intention, an individual can stop the

movement of the object which may be perceived, for example, to be slowly *spinning* in a clock-wise direction, and cause it to turn in the opposite direction. Thus, as a result of his *instruction*, the observer puts a particular kind of motion into objects which are physically fixed and unmoving. The student will recognize that the physical conditions are held constant. The stimuli do not change except repeatedly to come and go. The sense-organs presumably do not change. The sole change is in the purpose. Thus, the psychological property of movement is determined, in part, by a psychological factor.

At other times, an individual may sit quietly in darkness and look steadily at a weak light which is anchored to the wall across the room from him and see it swing back and forth or travel slowly over the dark field ahead of him. He can later discover for himself that the lamp is firmly fixed to the wall. Finally, if he will hold one finger before his face and will fixate beyond it so that he sees it as being doubled, and will then open and close *one* eye, he will clearly see movement as the doubling of the finger disappears and reappears. In this case, the temporal interval is really zero, for two objects are actually perceived until the one eye is closed.

d. All Physical Changes Involving Movement Are Not Perceptible. Physically speaking, the movement of many objects is without effect. The hour hand on a watch, the creeping shadows at noon, the elongating tip of a growing plant may be seen to be at different places upon subsequent observations. But the rate of physical change in these cases is too slow to affect man. If the rate of change is too fast, only a blur (no sharp outlines) may be perceived. Physical change in fact may be so rapid that even fast cameras cannot record it. There are, then, very definite and determinable upper and lower limits for psychological movement. Physically speaking, however, the upper and lower limits of motion rest upon the delicacy and the precision of instruments of physical measurement.

e. The Rôle of the Retina. The rate and the extent of perceived movement of an object vary with the particular part of the retina which is involved in seeing. In the extreme periphery of his eye, for example, an individual can see movement when perhaps he cannot see other properties such as the *color* or the *shape* of the moving object. If he will stare fixedly ahead and then bring his wriggling finger very slowly forward from behind his head on a

level with his eye, the student will clearly see *movement* as one of the very first properties. But he will not see that which moves as having the property of shape. It is, visually regarded, something at a certain place that moves at a certain rate over a certain distance. All this must be taken to show simply that the property of movement may at times really persist after other properties of perceived objects have disappeared or before certain other properties appear.

f. Racial Heritage. In this type of visual perception, eye-movement and after-images may, at times, play some part. The physical movement of the eyes in dizziness usually contributes to the perception of movement in surrounding objects. The human organism is very definitely disposed to perceive movement in its visual field. The ease with which man can observe the property under so many unlike conditions appears to be a striking form of evidence attesting to this fact. The survival value directly attached to an individual's ability to perceive movement is very great. Subhuman organisms seem to be very keen in this particular respect. We know that many undomesticated animals will unhesitatingly approach the place where a man is sitting as long as he remains perfectly quiet. Some animals (wild turkey) when very near a man can be frightened away by movements as slight as those involved in the opening or closing of his eyes. We agree with Titchener that the perception of movement is essentially a racial heritage. It has come to man out of a long history. It represents at once a functional property of human beings and a product of evolution. It is relatively independent of any particular stimulus and sense-organ. Its determination in many respects is more intra-organic than extra-organic.[1]

In those cases of observed movement when the eyeball is gently pushed, the movement is also determined intra-organically. The

[1] Some students appear to hold that one must learn to see movement. This means that today a developing individual sees no movement. Tomorrow, he will have a little ability to see movement. The next week he will be more able to see movement, etc. We assume simply that one may see movement as immediately as one sees color. We do not assume that one has always to see some object of a particular size or shape in motion because, as a matter of fact, one does not. We assume that an infant may see movement from birth even though it may not see any particular object. There should be no more mystery about this phenomenon than there is about the acidity of a chemical substance. Some animals seemingly observe movement immediately after birth. If babies could move as easily as young animals do, we would know more about human psychology.

pushing is itself no *stimulus* to any particular sense organs of movement. It does, however, change the nature of relations between the organism and its environmental sources of energy. The retina is accordingly shifted back and forth while the pattern of physical energy from outside sources remains unchanged. As a direct result, we observe movement (just as in the case of properties of color, size, and distance) as being an outstanding characteristic of the *objects* of the environment. We see them in movement. Finally, as we have said, the eyes themselves move rapidly in many cases of dizziness. But even here the perceived motion is again a property of the environment. The normal individual *is quite unable to observe that his eyes are in rapid motion.* The same is true of the intoxicated man who has lost partial control of his eyes and who may accordingly wait for the chair to move around to him before he attempts to sit upon it. Such striking cases of observed movement of objects where there are pronounced but personally unobservable eye-movements of an individual should be considered in connection with what has been said about eye convergence and the perception of distance. We should normally expect to see some observed object move rapidly toward or away from us as our eyes move in and out (convergence), if such eye-movements are really major factors in determining distance.

g. The Gestalt Approach. Koffka has assumed in the case of the perception of movement that, where two objects like those in Fig. 32 are presented in succession, two different areas of the brain are aroused in succession. The brain energy from the first area tends to involve — pass over to — the second area. This assumed shift in the neural energy from one part of the brain to another part is regarded in all cases where there is no *physical* motion as being the physiological or neural basis of seeing an object move across the visual field. When the degree of spatial separation between the two objects in the visual field or between the two brain areas is too *great*, no integration or combination of them into a single *whole* or pattern is possible. As a result, no movement is seen.

When the time interval between two successively seen objects is also so great that no connection between the two brain areas can be formed, the two objects are seen in succession. One of them is perceived. It then disappears to be followed after a time by the other object. The spatial separation and the time interval can

each be somewhat lengthened, if the intensity of the physical energy is so great that the brain process in the first area is so much stronger (so intense) that it can consequently reach out to a greater distance (roughly like waves formed by a rock thrown in water) or can last longer and so become integrated with the second brain area. In no case, however, can movement from one object to another be seen until a *total brain pattern* has been established between two successively functioning brain areas.

Visual movement of objects is, at all times, both elementary (irreducible) and meaningful. Since it is only one of many kinds of psychological properties, its meaning is limited. The so-called analysis of a single moving object into non-moving stages naturally destroys the movement. This very sensible emphasis upon the unitary character of perceptual products appears to us to be wholly commendable. Movement is unquestionably a unique, dynamic psychological property of an object. It cannot be reduced in part to some other status; neither can it be analytically described in terms of other things. This would be analogous to reducing one property of water to another property. But one can speak descriptively of its *speed*, its *direction*, its *extent*, and its *uniformity*. Each of these can be related experimentally to changes in various conditions within the individual (intent) or within the environment (time, space, and intensity). This is about as much as one can hope to do in any experiment.

h. Movement Is Wholly Relative. All that we have been saying may be summed up in this way: The psychological property of movement, although an essential characteristic of an object, is wholly *relative* to the organism. There would be no movement such as we have described here if there were no organism equipped to function in a certain manner in a particular situation. One may sit in one railway train, watching another train on an adjacent track. Now, when one of these trains starts moving, the individual can perceive the movement, as belonging either to his own train or to the other train. He can actually shift the movement back and forth, just as other meaningful characteristics can shift in other ambiguous situations (see Fig. 2). Or, one may stand quietly looking down upon a *moving* stream and clearly observe that he is moving up stream. The movement simply dominates the whole situation. There is nothing strange, therefore, about such perceptions. Let us glance at one more illustration.

Even where there is very pronounced *physical motion* in each of possibly thousands of objects surrounding an individual, there may be absolutely no *psychological* motion. The individual sees no movement. Perhaps the next few lines will both interest and instruct the student. If properly understood, they will make clear the essence of our position as we have tried to develop it in this chapter. Here is a short description of one of the many experiences possible for any curious individual who drops down to the bottom of the ocean. Beebe tells of pausing while close to the ocean floor by clinging to a mass of sea-weeds in order to watch an enormous turtle that floated motionless a few feet above him. Suddenly, he said, "I made a discovery in Einstein relativity — the turtle was quite motionless, yet not motionless." At the particular moment of this discovery Beebe had lowered himself so that he stood upon the bottom. "I looked up and was as astonished as if on land I should suddenly see the moon or the sun beginning to bob rapidly back and forth, for my turtle was behaving like everything else around me and was being swayed back and forth with every surge of the tide. By swaying with the tide (with feet off the bottom) I could give my turtle absolute stability, or by fixing myself to the bottom, rhythmical swaying through space." [1] At one moment the turtle had one property — it was a moving turtle. At the next movement, it had another property — it was a motionless turtle. We shall later discuss other relations. We shall, for instance, make clear that a stationary animal is to be dealt with in one way; a moving animal in another. An object is likely to be more harmful when it moves than when it remains quiet.

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OUTLINE

CHAPTER VII. AUDITORY, GUSTATORY, AND OLFACTORY PROPERTIES

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CHAPTER VII

AUDITORY, GUSTATORY, AND OLFACTORY PROPERTIES

I. Auditory

We have dealt with various *visual* properties of environmental objects which emerge as a direct resultant of the unlike relations sustained between a human being and the sources of energy which surround it. The several psychological characteristics of perceived objects are the direct products of certain functions of an individual. Psychologically speaking, a human being's environmental objects are what he himself causes them to be. Their several properties depend upon his activities. A change in his mode of functioning, as we have said, is generally followed by a change in the nature of the product. In this manner, new psychological properties may appear or old properties of objects may disappear or change. No single thing — either living or non-living — can be adequately *defined*, *described*, and *explained* apart from the nature of certain relations which it must necessarily sustain toward other things. Since human life never occurs in isolation, an examination of its relations to environmental things must furnish a type of understanding of it quite impossible to secure in any other manner. We have been interested in considering some properties of objects which man, because he possesses vision, is able to observe. But man also sustains through audition many other significant relations with his environment. We turn now to consider indirectly those *functional properties* of man as a result of which environmental objects are auditorily observed. Man hears objects in terms of their auditory properties just as he sees objects in terms of their visual properties.

A. *The Various Auditory Properties*

The auditory properties of an experienced object are commonly non-spatial; they do not have length or width. But like all

visual properties, they definitely qualify man's environment. He clearly perceives various objects around him to be dissimilar in so far as their auditory properties differ.[1] Two objects which are visually perceived may differ greatly in color. Two objects which are auditorily perceived may differ in tone, as well as in noise and locality. A violin and a cornet will be perceived by the normal individual to differ from each other in terms of their auditory properties. It is as impossible, psychologically speaking, to reduce all the various auditory properties of one kind of instrument to those of another as it is, chemically speaking, to reduce the several properties of one substance to those of another. One or more properties of two objects may be *alike* — but not all. One kind of property may serve at times to differentiate objects.

a. **Noise Properties.** Noises constitute one large class of auditory properties of perceived things. The many objects of an individual's environment differ widely in terms of these particular properties. Some are loud, and others are soft. Some are continuous, and others are abrupt. They all seem to be harsh or rough — at least, to a greater degree than is usually true of tonal properties. If the student will briefly consider some of his many environment objects in terms of their unique noise properties, this point will become apparent. The rumble and roll of bass drums, the rustle of grass, and the snap and pop of green wood burning are known to every one. Both human and non-human objects are definitely characterized in part by their noise properties. Such properties may be said, within limits, to differ from tones in terms of the degree of their roughness or harshness. Yet the roughness of noise properties may possibly be observed to a lesser degree in what are commonly recognized as being tonal properties. This is especially true both of very low and very high tones. Moreover, certain noise properties can be partly related in terms of their pitches to certain tones. The ordinary dance orchestra, for instance, with its squealing, squawking, and shrieking instruments, deliberately seeks to capitalize upon those kinds of noises whose pitches are somewhat related to the tonal properties of the instruments. Whether it succeeds in producing music apparently remains a question of definition and taste.

[1] Let us note in this connection that Woodworth, for example, raises the question: "Do we hear sounds, or do we hear objects? The answer with regard to noises would certainly be that we usually hear them as the sounds produced by objects."

b. Tonal Properties. Tones comprise another large class of auditory properties of environmental objects. Such properties differ among other ways in pitch; that is, one may be higher or lower than another. An analogous case can be found in vision. As we have said, one property may differentiate two visual objects. Thus one gray object may be lighter or darker than another gray object. Normal human beings can possibly perceive, under careful experimental conditions, as many as 11,000 different tonal properties or pitches. The tones, like the noises of objects, also differ in degree of *loudness* or intensity. Any object may vary considerably in this respect. If an individual will gently pluck a violin string, he may observe auditory properties of a certain degree of intensity. If he then plucks it more vigorously, other properties of a different degree of loudness may be perceived.

The *beating* sounds of an object show very clear variations in intensity. They are now loud and now soft, or now strong and now weak. The student while riding in an automobile may have occasionally observed upon overtaking another car that the motor in his car suddenly sounds quite differently. There is an observable rise and fall — alternation — in intensity. The motor seems to throb or pulsate. This auditory property is even more noticeable in those types of airplanes in which some of the motors are not properly synchronized. Travelers often complain about the unpleasantness and the monotony of the pulsating roar. These intensive differences in the sounds of object may follow each other either relatively slowly or very rapidly. There may be only a few per second; or there may be so many that it is impossible to count them. As the number of intensity variations increases, the sound property of an object may gradually change, thereby becoming harsher and perhaps less pleasant. Under strict laboratory conditions where a less complex stimulus pattern may be secured, a considerable increase in the frequency of the variations results, for instance, in disappearance of the beating tone and in the appearance of a *difference* tone which is lower in pitch than the former tone. Because it is somewhat harsh, this new tonal property shows a strong resemblance to noises. In this connection, we may note an interesting phenomenon. Here are auditory properties which may definitely begin (are at first observable) as tonal properties which fluctuate in intensity and

which may end, finally, by resembling noises. In this case, where a constant change is made in the physical conditions — vibration rate — of an object, there is a gradual and accompanying change in its psychological properties.

c. **Timbre, Fundamental, and Overtones.** Even under rigorously controlled laboratory conditions, it appears impossible to secure either a single wave or a single psychological property in complete isolation from all others. Moreover, the difficulty of controlling the organism (sense-organs and brain) is itself very great. One cannot speak, then, of a simple stimulus and of a single end-organ which works independently of others. The causal conditions are always complex. The *C* of a piano, for example, is unlike the *C* of a violin. It is understood that the auditory properties — both tonal and noise — which are peculiar to a sounding body constitute its timbre. Each musical instrument accordingly differs from all others in terms of timbre. Human beings also differ in this manner. We commonly arrive, therefore, through auditory perception, at a class meaning of our many environmental objects in terms of their timbre.

In addition to the various noise properties involved in the ordinary musical instrument there is also a *fundamental* tone with its several *overtones*. Each overtone differs from the fundamental in pitch. The former is higher than the latter. The timbre of an object may be modified by changing, i.e., *damping* the physical conditions. But, regardless of the change, the resultant property retains its unity. We simply say the object has been changed. The unity in this case may be directly compared for purposes of understanding with that to be found in the perception of visual movement. Each — timbre or movement — is, psychologically speaking, an elementary property; each auditory property of an object is simple. While the method of psychological analysis shows that different auditory properties characterize man's environmental objects, it does not show any of them to be directly derived from simpler phenomena. This is to say, the timbre of an instrument may be related physically to very complex wave patterns. Many of these may be isolated by means of a selective physical apparatus. But this does not prove that what one hears is composed of a number of simple parts. The noise and tonal properties of an object *are*, in part, that object. If they are changed, the object is thus changed.

d. Chord and Melody. In the chord and the melody an individual perceives auditory properties which emerge as a result of the very nature of the organism and the way the various sound waves are related. The property of the ordinary chord or the melody is, we assume, as primary and irreducible as any other psychological property which we have discussed. We know through observation that each may be heard just as immediately and as directly as the color or the size of an object may be seen. Various auditory properties which may be *simultaneously* combined to produce, in part, a chord, may also occur in *succession* to contribute to the melody. Here two totally dissimilar properties — chord and melody — arise as a resultant of the particular way in which other properties are integrated. Out of the integration there emerges a unique property. That is, the organism functions under one set of conditions to produce the chord. But under a different set of conditions, it produces the melody. In terms of stimulation, for instance, the situations differ essentially in their *time* relations. The physical properties of the sounding objects may actually remain identical except with respect to the time or the order of vibrating. This difference, however, is extremely important when regarded in terms of its effect upon the functioning of the organism.

Certain visual properties may be said to integrate harmoniously, but others do not. Certain auditory properties apparently go well together, but others do not. Several tones may integrate to produce another tone.[1] Some auditory properties show a high degree of *consonance*, and others show much *dissonance*. While the octave, for instance, shows one kind of property, the seventh shows a wholly different sort. The resultant property in this latter case is both harsh and unpleasant. A melody, too, is to be regarded as being more than the mere *sum* of several sound properties of varying degrees of loudness. Psychologically speaking, it is not a sequence of sounds, strung together like beads on a string; nor is it at all dependent upon any single set of auditory properties. It may be whistled, hummed, sung, played on a musical instrument, or tapped out on pieces of wood or steel. The melody of an object is perceived as immediately as any other auditory characteristic. It possesses unity; it cannot be divided or reduced. If an individual tries, he may

[1] Stumpf, for instance, holds tonal fusions to be simple and unanalyzable.

possibly perceive some of the other auditory properties which accompany a melody. In so doing, however, he must necessarily disregard the melody itself. While he does not need to learn to hear melodies, he apparently does require training in order to be able to *disregard* them. Should he take this abstractive attitude, he may simply observe another kind of auditory property of an object.

e. **The Property of Locality.** An individual may not only perceive the tone, noise, or melody properties of some object, but he may hear or localize it. It may have a particular place reference or *meaning.* This property of placeness or locality may vary from that sort to be found in an object "that is perceived to be in many positions or all about the individual" to that of the typewriter heard in the adjoining room. Although auditory properties may directly refer to the observer's himself, as when his head rings or his joints creak, they are more often referred beyond the organism; that is, like visual properties, they are usually characteristic of environmental objects. Generally speaking, audition does not equal vision in the certainty — spatial exactness — of place reference. Vision seems to place an object more quickly and with less ambiguity than does audition. Vision, too, seems to assist or to affect audition more than audition does vision in the localization of objects.

Just as the two eyes coöperate jointly in the visual localization of environmental objects, so the two ears may definitely contribute to the auditory localization of the same objects. A glance at a dog[1] or a horse that is listening to some object is sufficient to show the constant use made of the two ears. If an individual will call or whistle softly to such an animal, its ears will go back and forth, while at the same time its head will be turned in the direction of the sounding object. Generally speaking, a human being seems to be auditorily unaware that he possesses two functioning ears. This must unquestionably be true of the very young child. As a rule, it is only when one of his ears becomes non-functional that an adult individual may discover their actual value to him as an aid in localizing objects around him. But, even though he may be completely lacking one functional ear,

[1] Some dogs distinguish a sound source less than 1 degree away from the median plane. Most human beings require a difference of about 4 degrees in order to discriminate in this way.

an individual's object localizations ordinarily do not suffer greatly. For he can easily move his head to the right and the left, should he have any doubt concerning the particular place of an auditory object and so aid himself in its localization.

The apparatus shown in Fig. 34 may be used in the psychological laboratory to study the nature of auditory localization. The auditory field of the subject who sits within the apparatus is divided here for experimental purposes into three planes, *namely*, median, horizontal, and transverse. In this particular apparatus,

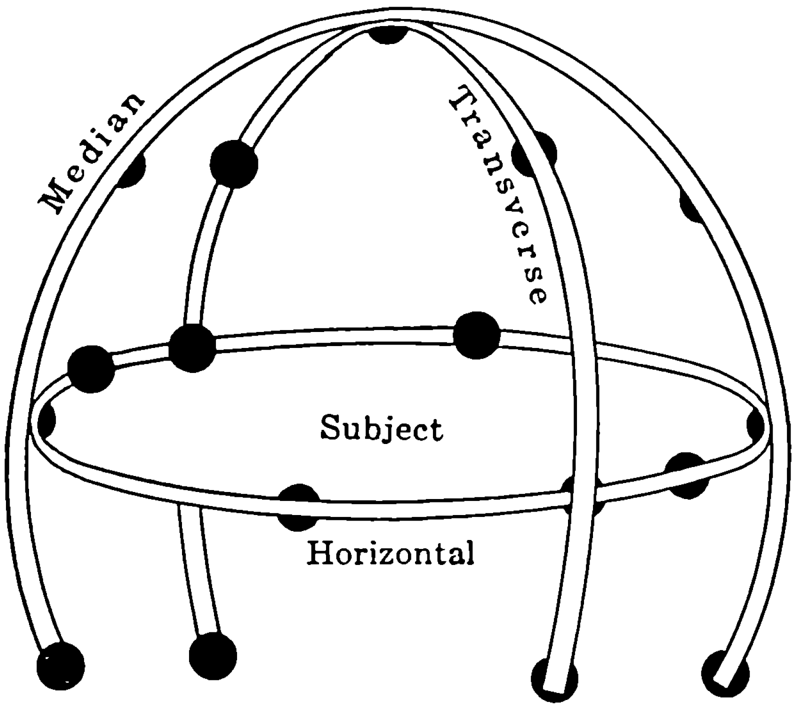

FIG. 34. Apparatus used in studying auditory localization.

seventeen stimulus positions are distributed among these three planes. The experimenter is so placed that all distractive properties can be wholly eliminated from the visual and auditory fields of the observer. After a particular stimulus source has been presented, the individual reports the place of its localization to the experimenter by pressing one (or more) keys in front of him. Varying degrees of accuracy in auditory localization may be computed from such studies. As far as individual observation is concerned one object is seemingly as easily perceived as another. In each case, if he is observant, the individual hears an object at a certain place. There are, therefore, no varying degrees of difficulty of observation. But the experimental results show in general that particular place accuracy is lowest in the median plane. In this particular case, each stimulus position is equidistant from the two ears of the observer. Studies have shown that faintly heard objects tend to be localized to the rear, while those which are clearer tend to be referred to the front region of the auditory field. Accuracy appears to be greater in the anterior

than in the posterior regions of this plane. In each of the positions in the *other* planes, one of the individual's ears is nearer the stimulus source. Such differences produce differences in localization.

As we have said, the introduction of visual functions may definitely affect auditory references or meanings of locality. Data obtained from experimental studies in which stimuli from the right auditory field are conducted into the left ear, and stimuli from the left auditory field are conducted into the right ear (see Fig. 35), indicate that the use of vision materially influences auditory localization. When an environmental object is seen, auditory localization becomes more *certain.* Moreover, the type of *verbal* instruction may affect auditory localization. If an individual is told, for example, that the stimulus source is to be given at a certain position in the median plane, he clearly tends to observe it there. In a larger percentage of the cases where no *definite* instruction is given, the observer perceives the objects when stimulated in the median plane as being in some position back of his visual field. Where no movement is to be seen *ahead* of him, he tends more often to perceive the auditory objects as being *behind* him. This fact makes more understandable the effects of vision upon sound localization. When an individual sees ahead of him the object which is presumably sounding, he is set, *as a direct result of his personal history,* to hear it where he sees it.

FIG. 35. Pseudophone used by Young to shift auditory stimuli.

Experimental evidence indicates that intention, instruction, or set seemingly determines, *within limits,* the nature of auditory locąlization or place meaning of objects. In this general connection, we wish to mention those very fascinating auditory localizations of our childhood days, when we heard the puppets on the knees of the man — ventriloquist — speaking to us. Then, in our naïve way, we thought that, by some bit of magic, the man actually was able to "throw his voice" into them. We know now that we ourselves were actually doing the work of localization. We put the sounds into the mouths of the puppets. The visual

perception of the *moving* "lips" of the puppet and the *non-moving* lips of the operator contributed, in part, to the desired effect. There was certainly no clearly formulated personal instruction on our part to hear the sounds as issuing from the puppets. The whole situation really took care of that. And our ignorance definitely inclined us toward such auditory perception. Our history accordingly determined the meaning both of what we heard and of the place meaning — property — of the sounding object. Cases of this sort are restricted to a fairly narrow region.

An adequate description of some of the determining factors involved in auditory perception must necessarily include references to the conditions of the stimulus (physics) (a), to the structures of the ear (anatomy) (b), to the functions of the ear (physiology) (c), and to psychology and heredity (d). Since we have reviewed in considerable detail the general nature of the intimate relations inevitably existing between a given psychological function of an organism and a total situation, we shall pass lightly over this phase in our discussion of auditory perception. It must be clearly understood, however, that the auditory property which is observed at any given moment is determined by a fairly large number of conditions both inside and outside the organism, and that a change in any of these factors may possibly be accompanied by a very significant change in the nature and the degree of the functional output or product. As evidence of this, let the student hold his nose tightly, close his mouth, and blow forcibly. He will instantly find that the auditory properties of many of his environmental objects are different from what he normally perceives them to be. In this particular case, the change is directly attributable to a difference in the degree of air pressure within his middle ear. This is comparable to the changes which occur in chemical substances under an increase in pressure. Any other single change may similarly entail other changes in properties.

B. *Explanation*

a. Physical. 1. *The Physical Nature of Sound.* Physically regarded, the entire world of sound resolves itself into one large class of phenomena, *namely*, air vibrations. A single wave (*AB*) is shown in Fig. 36. The sound world of physics is *entirely different* from that which is directly perceived by the physicist, the psychologist, and the student. The air vibrations or waves which

come across the space between a functioning individual and the stimulus-objects — *sources of energy* — of his environment are, as a rule, extremely complex. They show many unlike physical properties. An individual observes neither the waves themselves nor their physical complexity; for, in common with all other kinds of stimuli, they are wholly submeaningful phenomena. A human being (scientist or non-scientist) is actually no more able to perceive directly such forms of physical energy as sound waves than he is such phenomena as radio waves, X-rays, or cosmic rays. Physical energy is not observable. Piccard and others who have reached the stratosphere took readings in their physical studies there by means of *delicate instruments*. More recently, physicists have sent balloons to the stratosphere with a radio attachment that relayed physical changes to the scientists who remained in their laboratories. The student can quickly determine how far he can go in observing sound waves by snapping his fingers and by attempting to observe the nature and the number of air vibrations that are thereby produced. There is, moreover, no kind of apparatus which he may put on or use that will increase the acuity of his eyes or ears to such a degree as to enable him to experience these wave-trains. He will always perceive directly only the psychological properties of objects. He may be aided by a microphone, for instance, in hearing new objects or in hearing old objects more clearly.[1] The stethoscope, too, may help him in listening to the lungs or the heart. It may also be used to determine cracks or weak spots in certain industrial products. The physicist himself investigates many of his physical phenomena by using mechanical apparatus (sensitive diaphragms, fast cameras, vibrating flames, and the like) which may partially *analyze* and *record* the waves for him. He then reads the record. In these ways, the physical properties of sound waves are studied. When he has finally succeeded in breaking complex waves into less

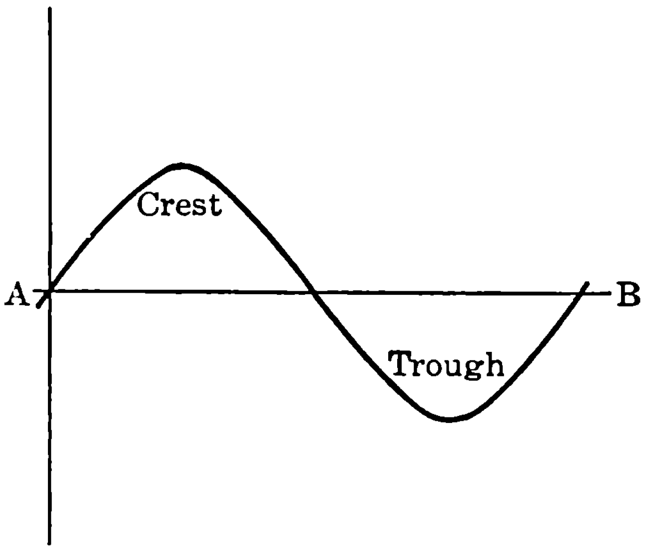

FIG. 36. A sound wave.

[1] A theater was recently opened in Chicago where "deaf" individuals may hear. Each is given a small oscillator which he places against any *bony* portion of his head (check, forehead, etc.). Normal audition may follow.

complex forms, the physicist has thereby lost or destroyed one very essential aspect, *namely*, those various physical properties which directly result from the interplay among the several waves themselves.

2. *Properties of Waves.* Physical experimentation and theory show sound waves to differ in (1) length or frequency, (2) amplitude or intensity (Fig. 36), and (3) purity or relative isolation from other waves. Perceptible differences between auditory properties of objects in terms of their pitches are directly related in part to the rate or the frequency of wave vibration. The lowest perceptible tonal property is related, for example, to a physical frequency of about 16. The waves here are around 65 or 70 feet in length. As this lower limit of auditory function is approached, tactual functions, as well as auditory, usually become involved. Thus an individual may actually feel as well as hear some environmental object, such as a pipe organ. The highest tone is possibly related to a physical rate of about 20,000 per second. The waves here are short. These auditory or functional limits depend, of course, upon various intra-organic conditions of the observer, including, among other things, his age.[1] An increase in age is generally accompanied by a significant shrinkage in the auditory limits of an individual. The number of auditory properties and the number of objects heard decrease. Children will accordingly hear many objects that adults do not. Herrick cites a case of personal observation where children could hear the bats which circled overhead in darkness but which the adults present were unable to perceive. The devices shown in Figs. 37 and 38 are sometimes used in studying the upper and lower limits of audition.

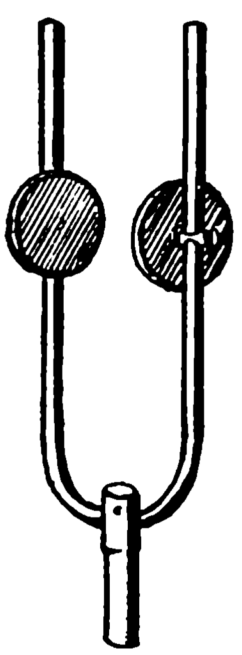

Fig. 37. Tuning fork used to study lower auditory limits.

3. *Loudness.* Loudness depends upon the frequency and upon the height of the waves as measured from their crest to their trough. The more frequently an organism is affected by a wave of a given height, the greater is the total amount of physical energy expended upon the organism during one second. The

[1] According to Seashore, if the upper limit is 30,000 for a normal individual at adolescence, it may be only 15,000 for him at the age of 70.

energy is also greater when the wave is higher because there is more force behind it.

4. *Timbre, Fundamental, and Overtones.* The physical conditions underlying the difference in timbre between two objects are partly a matter of the complexity of the sound waves. Let us assume, for instance, that three unlike wave-trains are set up by a vibrating violin string. One auditory property — fundamental tone — might possibly be related to a wave of 560. It is produced physically by the whole string vibrating as a unit. One half of the string also vibrates as a unit but at a rate twice as rapid as that of the whole string. Other parts vibrate at still faster rates. Two other tones might thus have the physical rates of 1,120 and 1,680 respectively. Some musical instruments produce relatively few, while others produce as many as fifteen or twenty of such secondary wave-trains. For all these waves, collectively regarded, there stands a particular class meaning (flute or banjo).

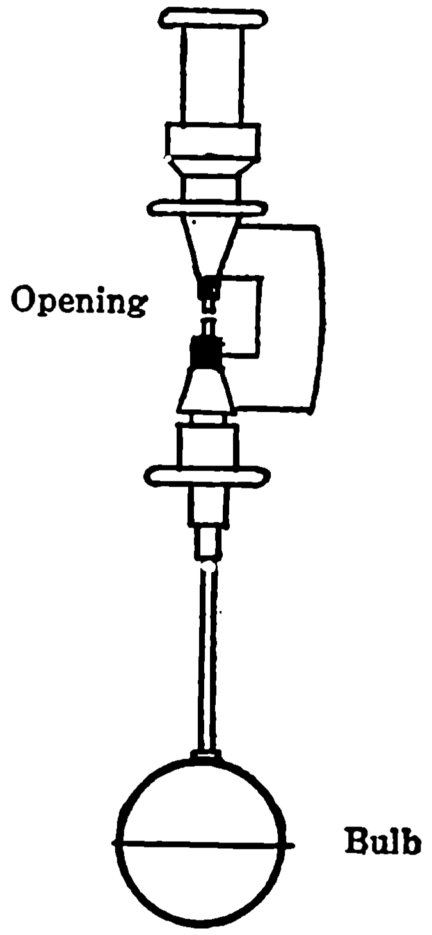

FIG. 38. Galton's whistle. Used in study of upper auditory limits.

5. *Tonal and Noise Properties.* Physically regarded, tones are in part periodic, uniform vibrations. They show many different forms. These are really physical properties which are discovered by use of physical methods, viz., vibrating flames, etc. Noise waves, on the other hand, are in part aperiodic, irregular, or discontinuous. If a uniform wave which serves as an auditory stimulus is cut off before one or two full vibrations are allowed to occur at the lower levels, or before ten to fifteen occur at the upper levels, a noise object or source may be perceived. Or, if two or more sound waves for some unknown reason do not harmonize properly, the same sort of property may be perceived. Several periodic waves, each of which under other conditions might produce some tone, may also possibly fail to integrate when they occur together. We may then perceive some noisy object.

6. *Beating and Difference Tones.* When *two* physical waves of about the same vibrational rate stimulate the organism, a property may be heard that is now loud and now weak. The observable increase in loudness comes when the respective *crests*

and *troughs* of the two waves coincide (see Fig. 39). Technically speaking, when the waves are in the same phase (crest upon crest and trough upon trough), the loudness is greater — the strength of one wave is added to that of the other. But when the sound waves are in opposite phases (troughs of the one wave against the crests of the other), they tend to cancel each other. The intensity of the sound of some object is thereby reduced or weakened. The number of these fluctuations depends upon a difference in the frequency between the two waves. In case of two wave frequencies of 400 and 405, for example, 5 pulsations may occur per second. As the difference in the frequency or the rate of vibration between two waves is gradually increased, two unlike properties become perceptible. Neither the sounds nor the waves apparently harmonize, and the resultant properties are rough and harsh. Under certain conditions, when the frequencies are separated still more widely, a third sound which is known as the difference tone may be observed. It has no "wave" to serve as its stimulus (physical basis) other than the actual difference between the two wave-frequencies which are also the physical bases of the two unlike properties. For example, if the frequencies are 400 and 500, a tone of low pitch corresponding to a vibrational rate of 100 will be perceived. There are, physically speaking, only two wave-trains in this particular situation; but there are, psychologically speaking, three auditory properties each of which is different from the other two.

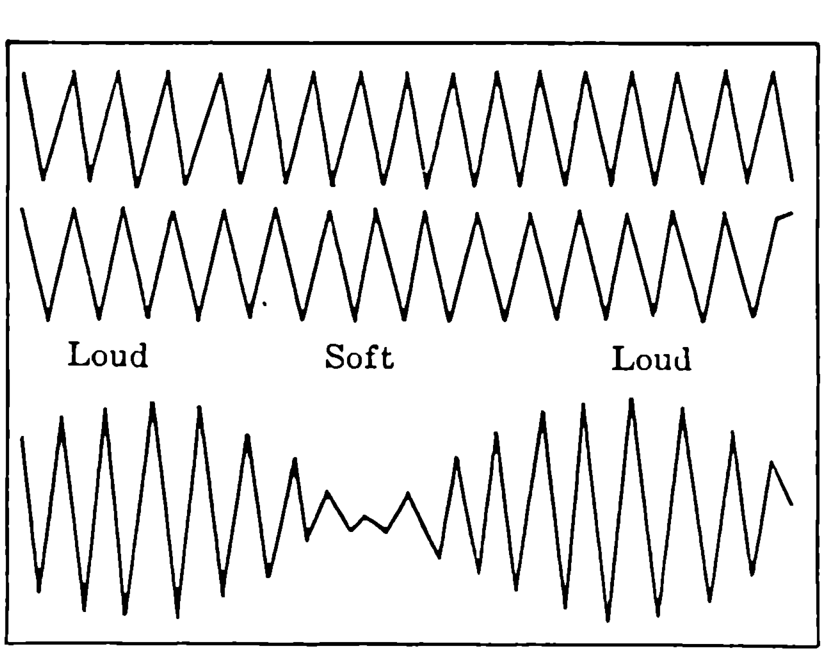

Fig. 39. A sketch of one form of physical integration.

The student sometimes assumes that the human being is itself able in some peculiar manner to analyze sound waves. He can no more do this than he can analyze light waves. A number of different objects may occur in any complex situation. The human being is able *to see* or *to hear* either different objects or different properties of the same object. He can hear, for example, in the case of a dancer the snapping of the fingers and the slap and the pound of the feet. In such cases as *beating* sounds, he is unable

to hear two different kinds of waves or objects. Psychologically speaking, there is one thing; but physically regarded, there are several things. The latter may be analyzed by means of physical apparatus.

7. *Integrations and Physical Ratios.* Different degrees of integration exist among the auditory properties of objects. Middle *C*, for instance, may have a frequency of 256. At an octave above it, the vibration rate is 512. The ratio between these two is 1 : 2. In this case, a very high degree of integration exists. In such cases, it is possible to hear only one property. At the frequency of 384, which is one half the distance between 256 and 512, is *G*, where the next greatest degree of unity (*C–G*) above the octave is found. Just why two complex physical waves should integrate in these particular ways, the physicist is apparently unable to state. Nor is any psychological clue to be found. Moreover, there is no evidence which indicates that an individual gradually learns, for example, to establish the octave as one of the most highly integrated auditory pattern; or that he is *unable* to learn to integrate other ordinary musical intervals fully as well as he does the octave. Since this sort of psychological integration — consonance — is so universally characteristic of man, students appear unanimously to accept a fairly strict form of determination through heredity to account in part for it. Now that we have briefly surveyed some of the physical conditions of auditory perception, let us turn to anatomy and physiology.

b. Anatomical. The receptors or sense-organs for audition are located in the *cochlea* of the inner ear. Here a thin membrane (basilar) is found to be stretched from the outer edge of a bony ledge (which extends out from one wall) across the middle of the cochlear chamber and to be attached to the other wall of this snail-like structure (see Fig. 40). Imbedded in the tissues of this thin basilar membrane are many thousands[1] of very slender, short fibers lying side by side not unlike close strings on a harp. These are the basilar fibers. The shortest of these fibers are from one half to one third the length of the longest. Some scientists assume that the shorter fibers are more tightly stretched than are the longer; and that the longer are heavier. Upon certain of these basilar fibers are located delicate hair-cells, among which are to be found the *ends* of slender, microscopic nerve

[1] Estimated at 20,000.

fibers which lead away from these small hair-cells to the cortex of the brain. They are the auditory nerve fibers which compose the auditory nerves.

c. **Physiological.** 1. *Telephone Theory.* That all the basilar fibers may possibly function in a unitary manner to carry, within limits, a vibration rate essentially like that of the physical wave-train — stimulus — appears to have been partially demonstrated. If this is true, then perceived differences among objects in terms of their sound properties are due mainly to differences in the way the *brain* functions. Some evidence upon auditory functions has been obtained by directly connecting the auditory nerve of an animal through an amplifying apparatus to a telephone. It has been possible, by measuring the frequency of the waves which are introduced into the ear of the animal as well as the frequency of the waves which are delivered at the telephone end, to show them to be quite alike at lower frequencies. The frequency of the stimulus and the frequency of the nerve are alike at certain frequencies, if such experimental results are valid. These conductive phenomena are seemingly dependent in part upon life processes; for when the auditory nerve is completely deadened or when the cochlea is presumably anaesthetized different results are obtained. But the reliability and the significance of the experimental results obtained in these cases are somewhat lessened by the difficulty of securing strict control over the various factors necessarily involved — by difficulties of experimentation.

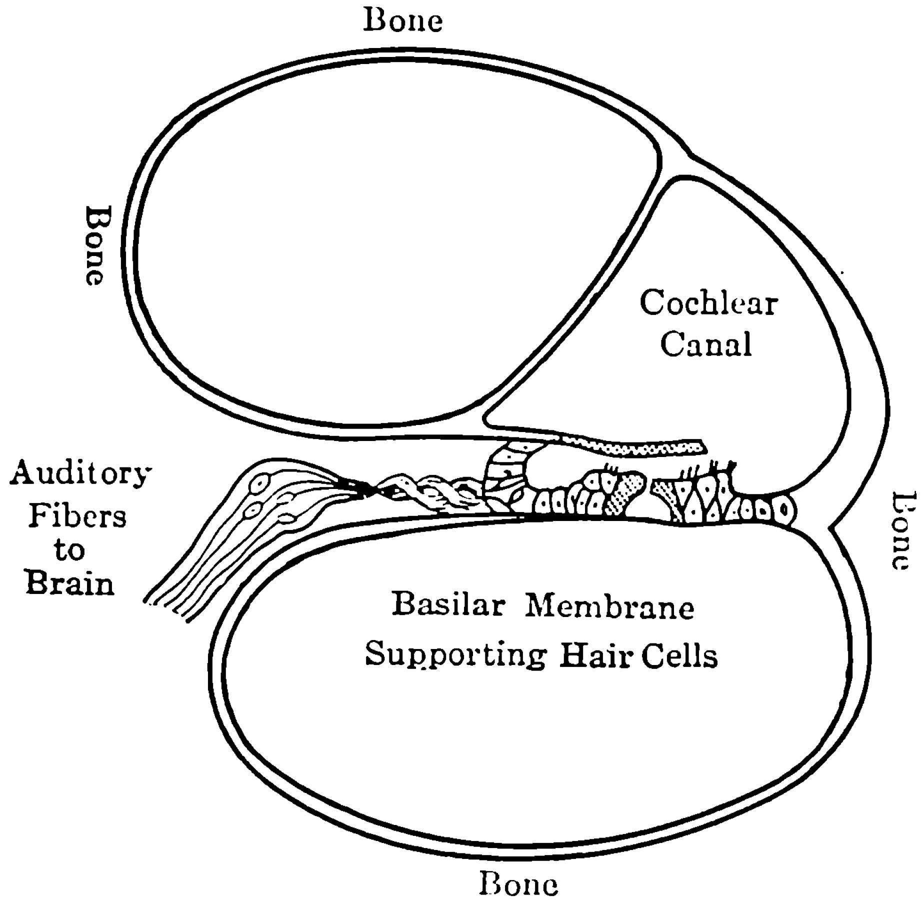

Fig. 40. A cross-sectional view of the human cochlea.

It is quite possible in fact to secure results, which are identical with those obtained when the auditory nerve is directly hooked up, by making the same kind of hook-up either with one of the two windows of the cochlea or with the *bony outer surface* of the cochlea

itself. In these cases, however, the data naturally cannot be interpreted as resulting from *neural* functioning. It is quite possible, therefore, that the results which are apparently secured from contact with the auditory nerve are not really produced by *neural* changes. That is, the similarity between the waves which are introduced into the ear and the waves which issue at the telephone end is not to be regarded as actual evidence of some physiological property of the auditory nerve whereby sound waves are transmitted at the same frequency they show at the time they enter the cochlea. Since they are quite like those secured from contact with the *bones* or other *non-neural* portions of the cochlea, it may be possible that there is always conduction, even in those cases where the auditory nerve is supposedly tapped, by other (non-neural) tissues and materials such as fresh blood, small remnants of flesh clinging to the nerve, and watery fluids.[1]

2. *Sympathetic Vibration Theory.* Every individual must have observed that when he speaks at a certain pitch into a piano, certain strings hum. They may be both heard and felt. When he changes his voice, other strings in turn hum. This principle has fairly wide application in the world. A number of years ago, Tesla showed quite simply that a large iron structure could be made to tremble perceptibly by the use of a very small vibrating mechanism when it had been properly tuned to the assumed vibrational rate of the structure. It is also known that a bridge may be endangered by a body of men if they march over it at a rhythmical gait. In these cases, something like the principle of sympathetic vibration is presumably involved. In the case of audition, it is assumed that certain basilar fibers have a certain vibrational rate. Their rate in each case varies in part with their length. The shorter fibers are assumed to vibrate more rapidly than do the longer. The former are involved in the perception of higher ranges of auditory properties, while the latter are concerned in the production of the lower ranges of auditory properties. The intensive aspect of any particular auditory property is assumed to depend largely upon the total number of fibers involved at any given moment as well as upon the total force of their vibration.

[1] Adrian, for instance, suggests that electrical changes may be carried by various tissues including the auditory nerve itself so that these results are not due to the action currents (neural impulses) of the auditory pathway.

Because of a biological difference in tuning, established as a definite hereditary property of the organism, the functional level of some of these basilar fibers may be definitely raised by a certain vibration rate of the stimulus, while other fibers remain at a lower functional level. The vibrations of the physical wave-trains are directly transmitted through the eardrum and the middle ear to the cochlea of the inner ear and cause the fluid (endolymph) contained in it to vibrate. This vibration in turn

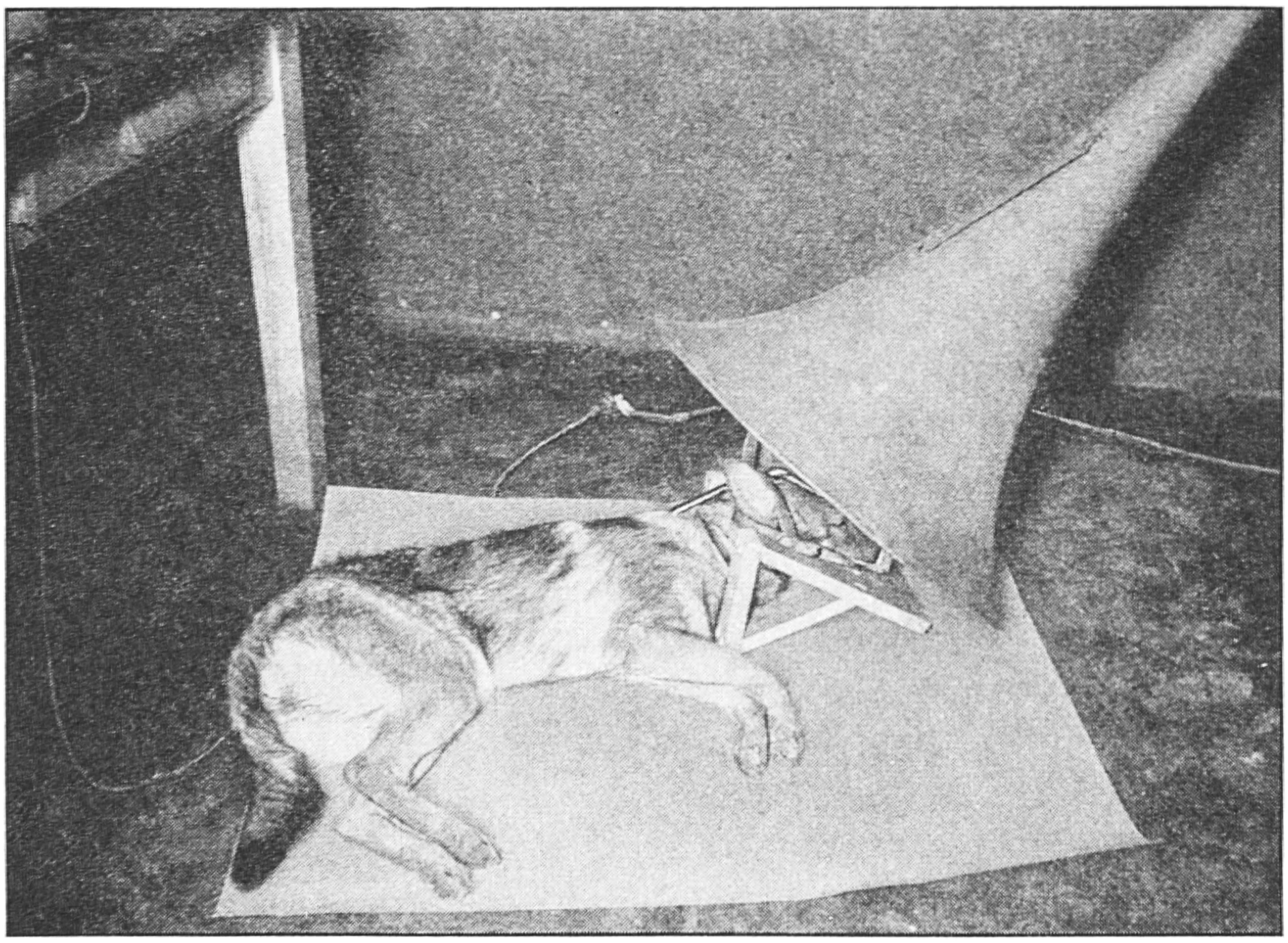

FIG. 41. Method used in prolonged stimulation of an anaesthetized dog. (From Culler and Finch.)

raises certain basilar fibers to a functional level. Their vibration in turn excites the delicate hair-cells, scattered among which are the tiny ends of the auditory nerve-fibers. The functioning of the *latter* is one necessary condition — among several — for an environmental object to be auditorily perceived. If a number of basilar fibers are simultaneously raised to the functional level necessary for perceiving to occur and if they vibrate periodically, an object may be heard in terms of its noise properties. When a few vibrate periodically, the tonal properties of an object may be perceived. When these fibers are properly integrated functionally, various unlike properties of environmental objects may be observed.

Experimental and clinical evidence. Experimental and pathological evidence seems in part to confirm a type of explanation which is put in terms of a difference in functional tuning whereby certain limited areas, instead of the whole basilar membrane, are involved in the production of particular auditory properties. Certain scientists claim that the anatomical evidence obtained from post-mortem examinations shows that certain stretches of sensitive hair-cells and basilar fibers of animals and human beings which have been constantly exposed over fairly long periods to very high or very low vibrational rates have been partially impaired. Experimental work in this connection has been done on various animals (see Fig. 41). In these subjects, long exposure to very high vibrational rates appears to produce *structural* losses at the shorter end, and very slow vibrational rates similar changes at the longer end of their basilar membranes. More recent studies[1] indicate that continued exposure of a dog to intense auditory stimuli is followed by a wide, permanent *decline* (not loss) in auditory sensitivity. The dog does not develop narrow gaps; it simply cannot hear as well as it formerly did over a wide range. The hearing of the dog may be compared with that of the long-flight "deafened" aviator, except that it is presumably permanent in the one case and temporary in the other case. It was formerly assumed that continuous stimulation with one form of wave (e.g., 1,000) would produce a narrow region of auditory loss or decline such as is shown in A of Fig. 42. Recent studies indicate, however, that a wide decline (250–4,000), as diagrammed in B of Fig. 42, occurs. The effects are not sharply localized. The animal is not "deafened," it simply does not hear as well as it did over this region (shown by B).

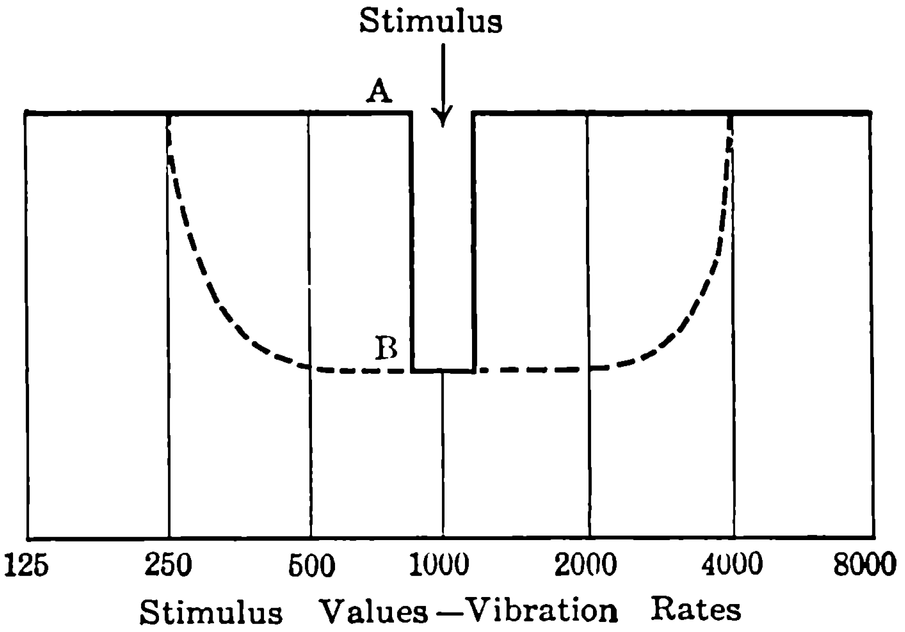

FIG. 42. Are the effects of intensive stimulation confined to a narrow region?

An examination of the ends of the cochlea by sensitive electrical devices also reveals that high notes are localized most strongly

[1] By Culler and Finch.

at the base and low notes at the apex of the cochlea. Naturally, no experimental work of this sort has ever been done with human beings. But there is a recognized occupational disturbance of auditory functions, known as the boiler-maker's disease, which supposedly appears after continued exposure to intense stimulation and which is characterized in part by a loss of an individual's ability to perceive the higher auditory properties of environmental objects.

There are, also, cases of functional losses among individuals as a result of which they are unable to perceive within a certain range, or to hear only when the *intensity of the stimulus* is greatly increased, although they have presumably done nothing to injure themselves. They are usually able, however, to perceive normally those auditory properties which are either higher or lower, that is, which lie on either side of these functional gaps. It is claimed that post-mortem examinations which have been made in some of these cases tend to show an abnormal anatomical condition along certain stretches of the basilar membrane which might possibly explain, in part, such perceptual losses. It is known, moreover, that animals (birds) which show an unusually narrow range of perceptible auditory properties have short basilar membranes with fibers of about the same length (Starling).

It is extremely difficult, however, to interpret pathological evidence of this sort in a wholly reliable manner. In most cases, no careful experimental checks have really been made, especially among human beings, upon the exact nature of these perceptual losses in audition. That such losses exist is not to be questioned. But whether a significantly close relationship can actually be established between (a) definite losses of auditory properties on the one hand and (b) degenerated basilar fibers on the other is a problem that can be satisfactorily answered only through future experimental work which shall supplement careful clinical findings obtained from pathological cases.

3. *Locality.* The position or place meaning of an auditory object is directly perceived by an individual; it does not appear to be an inference either from other auditory or from non-auditory properties. We can, for example, find no scientific justification for assuming an inferential basis for auditory localization in an adult human being and a non-inferential or *perceptual* basis in the animal and the young child. There can be no doubt, however,

concerning the localizing ability of either of the latter organisms. Most animals show this sort of perception very early in their lives. And within a few months following birth, children will turn their heads without apparent uncertainty toward the place (direction) of some sound source. There seems to be no acceptable evidence in these cases of some gradual *process of learning* through the correction (elimination) of discovered errors. Certainly there is, at least, no sensible ground for assuming an *inferential* basis for such localization at the animal and infantile levels. There is, moreover, no scientific evidence to indicate that any individual (animal, child, or adult) translates some non-meaningful thing into a meaningful object possessing locality or place reference. We wish to say that an individual is able not only to hear an object in terms of its noise properties, but to hear the object as bearing some place reference with respect to himself.

There are several causal factors involved in the auditory localization of objects. A slight difference in intensity of the stimulus may contribute in part to this determination. The ear which is nearer the source of physical energy will be subjected to a greater intensive degree of stimulation than the farther ear. This *physical* difference, of course, must necessarily be very slight, since the spatial separation of the two ears is so small. Again, a possible difference in phase relations of the sound waves presented to the two ears may contribute to locality. That is, the *crest* of the wave may affect the nearer ear, while the *trough* may act upon the farther one. The resulting *neural functions* give locality meaning or place reference to the observed object. The experimental data seem in general to sustain the claims for this type of determination. Finally, a slight difference in the time of stimulation of the two ears may possibly be a factor. Unless the sound source lies in the median plane, one ear is always stimulated earlier than the other. Studies indicate that in the greater percentage of cases when the stimulus source lies directly out from either ear, the observer localizes it correctly. Localization is poorest within the median plane. Under ordinary conditions of life, stimulus sources very seldom fall exactly in the median plane of the auditory field. Vision, too, plays a part. Auditory localization is, therefore, more certain when the sounding object is seen.

The stimulus conditions of localization, however, operate at a submeaningful level. It is certainly true in auditory localiza-

tion that an individual does not observe any difference whatsoever in intensity, or in phase, or in time between the physical wave-trains. We have no scientific basis for assuming that the animal, the infant, or the adult human being first *observes* slight differences in the intensity of two sound waves, for instance, and then later localizes the object in terms of such differences. Surely no one of these is able to observe either a difference in time so small that it must be measured in terms of the thousandth part of a second, or a difference in wave-phase when the waves themselves cannot be observed. What an individual actually observes is that the auditory object is here or is there with respect to himself; or, that it is around him and has no precise place reference. Other things being equal, each of these three general conditions of stimulation is no doubt directly responsible in part for localization. Certainly a source of energy auditorily presented in the median plane cannot be localized, as we have said, with a very great degree of accuracy. On the other hand, it is very seldom placed *outside* the median plane. In several thousand localizations upon stimulus sources given in the median plane (see Fig. 34) less than 5 per cent were localized outside this region. Individuals seemingly tend, within limits, to perceive alike.

d. Psychological and Hereditary. The psychological factors involved in auditory perception play an important rôle. In general, what we said in this connection concerning visual perception likewise holds true here. That there is a very strong inherent disposition to hear various auditory properties is quite evident. Moreover, the individual's *intention* or his *wish* to hear certain objects, and not others, determines to a considerable degree the nature of his perceptions. If he is sufficiently interested, he can talk with another in a noisy room where it would seem that intelligent conversation would be impossible. In such cases it is quite apparent, of course, that the individual cannot possibly increase or decrease the sensitivity of the tiny structures lodged snugly within his skull. The primary determination, or the major causal condition, of such auditory experiences is to be directly referred to psychological factors. That is to say, the deliberate intention (or necessity) to hear certain objects, which *unquestionably enables an individual to perceive so many things he would otherwise miss*, is purely psychological. Objects from time to time necessarily possess meaning because the organism

is listening for them. He is functionally prepared to observe them. At the same time, however, he is not prepared for other things. The latter may be observed, of course, but neither as quickly nor in as much detail. Often they are actually ignored. Anything which tends to facilitate the observation of an object or situation has psychological significance.

The orchestral leader, for example, can definitely instruct himself to listen at one moment for one certain instrument, and at another moment for another instrument. The extent to which he is able to perceive one particular instrument out of a group of many is a direct resultant of the training and the development of his perception along this particular line, but not from any training of his sense-organs, whereby their degree of sensitivity is actually increased. The naïve — uninstructed — individual may not be able to distinguish one instrument from another. He has not been prepared for such functioning. He simply does not know *what to hear.* In a very short time, however, if some instrument is sounded singly while he closely observes its timbre, he will then be able to hear it in an ensemble. But we do not assume, however, that his auditory sensitivity has been increased, even to the slightest degree, in this *short* time. On the contrary, he will still be unable to hear *other* instruments until he has been functionally prepared as in the first case. And when he has become able to distinguish each instrument in a group, there is still no scientific ground for assuming that his auditory sensitivity for other things (other situations) has been increased.

Man's past, therefore, determines in part his perceptions. Thus an individual may actually develop when measured in terms of his ability to perceive objects, although the limits of his sensory acuity may at the same time shrink. The student may have been surprised, at times, to discover how quickly the partially deaf person can hear certain things. Above all, he can both perceive and understand familiar things much better than he can the unfamiliar. Again, the uninitiated individual is strikingly unable to converse over a telephone in a noisy room. But the newspaper man, for instance, seems to do so without apparent difficulty. He is actually able, within limits, to *disregard* the various noisy objects about him. They sink into the background. But he does not usually attempt in any way to prevent the many thousands of unlike sound waves from beating into his ears. He

knows how a telephone sounds under these conditions, and he is able to ignore various other environmental objects which are not relevant — which do not fit into the picture. Each of us knows that the conversation (speech) of our friends is more easily understood than the speech of a stranger.

Every human being is normally deaf to a varying number of environmental sources and events. The objects he hears now may not be heard a moment later. His efficiency, happiness, and perhaps sanity would be impossible if such perceptual (object) selection were not possible. By selection we simply refer to the emergence of certain objects from the background or to the submergence of certain objects in the ground. Some objects stand out (emerge) at this moment, but are gone (unobserved) the next moment. How far such normal functional deafness to environmental objects may be carried can best be found in the experiences of certain abnormal individuals. Among such persons, there are some who show no discoverable structural deficiencies yet who steadfastly fail to hear certain objects around them while at the same time they easily hear others. The former objects are not heard because they are in no manner related to the necessities, purposes, needs, expectations, or problems of the individual. Except in degree, such individuals are quite like the very absent-minded but wholly *normal* person who completely fails, during a moment of intense observation upon a problem, to hear his best friend speak to him. Or, they are like the perfectly normal person who is expecting to hear an object — nurse sleeping near her patient — and who consequently perceives much more readily than do other individuals who have a different form of instruction or functional preparation.

The significant part played by hereditary factors in determining certain phases of auditory perception is most clearly shown in the lives of musical prodigies. At this time (1934), a nine-year-old girl is on a concert tour of this country. Rachmaninoff, who is interested in her, says that she is an extraordinary individual. Yet it cannot possibly be said of her that she is outstanding because she has spent long arduous years in developing her fine auditory sense and her keen discriminations.[1] The history of musical

[1] Seashore states that an individual may reach his finest use of pitch during his first year. Moreover, all the possible training after that cannot affect his discrimination. It varies neither with training, intelligence (normal individuals), age, nor

geniuses is replete with instances of extraordinary performances at ages when most individuals are actually getting ready for their first day at school. We must recognize, then, that in a small number of individuals there is an unusual degree of ability to perceive various auditory properties of objects; that in most of the remainder there is a normal amount; and that in a few cases this ability is largely or wholly lacking. Thomas Edison tells that he so wanted to sing that he took lessons, until it became evident that he would, indeed, do well if he could ever carry a tune. Most men seemingly perceive in quite essentially the same manner, because it is their common heritage to do so.

II. Gustatory and Olfactory Properties

A. *Introduction*

a. Their Value Is Mainly Utilitarian. At the entrance to the alimentary canal, guarding the organism which they serve, stand the various receptor organs of the psychological functions of taste and smell. Their great biological utility in matters pertaining to the selection and the rejection of suitable food objects or materials for the organism cannot be questioned. Although these functions serve quite well the important uses for which they are peculiarly fitted, the amount of aesthetic consideration which they commonly receive is very small, indeed, when compared with the amount awarded either vision or audition. In striking contrast with the two latter forms, the former functions seem usually to be regarded as being more primitive. While exceptions may no doubt be found, this attitude seems, on the whole, to be rather characteristic of civilized man. Among subhuman organisms, these functions apparently serve several unlike ends. In addition to their primary rôle of discovering and selecting food objects (prey), they apparently serve to differentiate friend and non-friend, as well as mate and non-mate. At the human level, smell may occasionally play a non-utilitarian rôle. It enters,

sex. He also points out that auditory tests when given to musically untrained individuals possess considerable predictive value. The traits which underlie musical talent can be measured in the lower grades and are little subject to improvement by training. Intensive differences are perceived as accurately by the child as by the adult. Training apparently brings no improvement here. Finally, discrimination of differences in duration of time intervals, he reports, varies only slightly with age, training, or intelligence.

at times, into an individual's larger sex relations and it contributes materially to the enhancement of some of his more purely aesthetic pleasures. The use of perfumes is quite old and almost universal.

b. In the Blind Individual. The possible significance of odor properties of objects becomes more apparent with a fuller understanding of the lives of many blind individuals. The earlier life of Helen Keller, for instance, furnishes a striking illustration here. As she grew older she apparently came to depend to a lesser degree for guidance and determination of behavior upon the olfactory properties of her environmental objects. Some of her remarks in this connection are rather interesting. They indicate functional potentialities which seemingly remain largely undeveloped in the normal individual. "In my experience," she says, "smell is very important. The sense of smell has told me of a coming storm hours before there was any sign of it visible. Smell gives me more idea than touch or taste of the manner in which sight and hearing probably discharge their functions. I have not, indeed, the all-knowing scent of the hound or the wild animal. Nevertheless, human odors are as varied and capable of recognition as hands and faces. The dear odors of those I love are so definite, so unmistakable, that nothing can quite obliterate them."

c. General Nature of Gustatory and Olfactory Properties and Their Relation to Behavior. In the normal individual, these two psychological functions are intimately related with cutaneous and kinaesthetic functions in the perception of food objects. An ordinary object upon being put into the mouth may be tasted; it may be smelled; and it may be felt both through the skin and the muscles. A food object, then, may possibly be qualified in several unlike ways. Various dissimilar psychological properties may be observed in it. These several properties (in the absence of possible visual and auditory types) *are*, psychologically speaking, the particular food object. These experienced properties also determine in every case what is to be *done* with the object — whether it is to be accepted or rejected as food by the individual. Thus, one may at one moment willingly accept a particular object because of certain properties which it possesses, but at a moment later violently reject it as a result of other properties which suddenly appear in it. In this connection, I clearly recall a trick played upon me years ago. I was given some small, round, red pieces of candy. After they had been in my mouth for a few

minutes and just when they were getting to be very "tasty," a new property suddenly appeared that brought their instant ejection. I had reached the quinine core hidden in each of them. The sweetness (candy) made them acceptable, but their bitterness (drug) caused them to be rejected.

d. They Are Psychological. The student should understand that a taste or an odor property is not a physical or chemical aspect of an object in the sense that the most searching sort of chemical analysis, for instance, will reveal such properties in addition to those of the analyzed chemical parts of the substances. What we have said in this general connection concerning the several visual and auditory properties of objects must also be accepted as being true of the taste and smell properties. The taste or the odor of any substance with which the organism comes in contact must be regarded as being one kind of property which it possesses because of the way in which the individual functions psychologically. It is something that exists in (characterizes) an object at the very moment that it becomes a part of the environment of an observing organism. It is, strictly speaking, a functional product of an individual. There is absolutely no reason for assuming that every person of a possible large group of individuals is able to smell the odor of a bouquet of flowers; or that, of those who are able, each observes exactly the same odor. The nature and degree of what is tasted or smelled, at any given time, are certainly dependent upon a large number of factors. If an individual suffers with diabetes, many, if not all, of his taste objects will definitely bear a sweetish property. Or, if he has jaundice, his gustatory objects all tend to be perceived as being bitter. Thus a change in one property (bitterness) may actually change all other properties by counteracting some (sweetness), by blending with others (sourness), or by enhancing others (bitterness itself).

B. *Taste Properties*

a. Experimental Method and Taste Properties. By controlling the temperature, odor, touch, and kinaesthetic factors, as well as the methods of presentation and stimulation, the taste properties of objects or substances may be experimentally studied. The juices of an onion or of an apple may be applied lightly to various parts of the tongue of an individual by means of a brush or a medicine dropper. His mouth may be rinsed with distilled water

after each application, and further observations made. Different soluble substances of unlike chemical constitution may also be applied to various parts of the tongue. In this way, an approach may be made to an understanding of the taste properties of objects. The many thousands of perceptible taste properties of objects can presumably be ordered under the very general heads of sweetness, sourness, saltiness, or bitterness. This does not imply at all that an individual observes just sweetness, or sourness; he always perceives objects or substances. In cases of complete anosmia (no smell), an individual may distinguish among such cooked things as cabbage, apple, potato, onion, carrot, and turnip and among such raw things as orange, grapefruit, pineapple, tangerine, and tomato. Gilliland, for instance, compared an anosmic individual with eleven normal individuals. The former was better than five and poorer than six of the latter in his taste discrimination of these objects.

There are, in reality, large *classes* or *families* of taste properties, each of which includes partly or wholly within its borders a *great many forms or variations*. That is to say, there is no such thing as a single property of sweetness or of sourness. There is only a particular sweet property of some particular object. Various kinds of sugars, for instance, show different kinds and degrees of sweetness. Some show less sweetness and more bitterness; some show no sweetness at all. Lead acetate, too, is sweetish, but it is also sourish. Tea, quinine, coffee, cocoa are bitter, yet the bitterness in no two cases is wholly alike. Baking soda shows both saltiness and sourness. Potassium sulphate is sour, but is also bitter. This is likewise true of a grapefruit or a lemon. Our foods would indeed grow monotonous if the sole taste properties were those of sweet, sour, salt, or bitter. In most cases, we must say of the taste of an object: *It shows properties common to two or more families.* At times, it is actually impossible to say to which *class* it really belongs. It seems to occupy a position on the boundary. Classifications then pertain to more or less gross resemblances. There are, literally speaking, thousands of slight differences in taste properties by virtue of which we can say that a particular property appears to belong to a large group, yet it is *wholly like nothing else in the entire group.*[1]

[1] This should add to the student's understanding of one type of analysis common to both science and everyday life. Thus we point out that a thing has unlike

b. Adaptation and Contrast. Adaptation appears among the taste properties as it does among the color properties. But it is not quite so striking in the case of taste. An object which, at first, is clearly perceived to be sour, tends very shortly to be less so. This is also true of the many other gustatory properties. Contrast, too, may possibly appear here. After an individual has partaken of a sweet dessert, his coffee may suddenly appear to be slightly more bitter. This particular difference in taste properties may be attributed in part, perhaps, to a condition of partial *adaptation* to the sweetness of the coffee with a resultant change in its bitterness. Titchener has pointed out that a previously imperceptible substance which has been applied to one part of the tongue may become perceptibly sweet if a clearly sour substance is simultaneously placed upon another part of the tongue. But it seems impossible to find many complementary taste properties which are able completely to affect each other in the same manner and to the same degree that complementary color properties do.

C. *Smell Properties*

a. Classes of Properties. In the field of odors, we also discover a wide range of perceptual properties. Every attempt to reduce these properties to the assumed level of sensation has been ineffectual. Here it is evident that an individual always observes one or more properties of a thing. "The fact," Bentley writes, "that most of our names for odors are borrowed from objects and chemicals suggests the difficulty of divorcing them from their sources" (p. 79). Pillsbury remarks that "there are no names for odors other than those of the objects that give rise to them" (p. 65). And Woodworth finds that "the great variety of odors has proved very difficult to analyze into any definite elementary sensations" (p. 327). The latter attributes this failure mainly to the *inaccessibility* of the olfactory sense-organs. The many odors fall, according to Zwaardemaker, into these groups: aromatic — camphor and spices; fragrant — flowers; ambrosiac — musk; alliaceous — garlic; hircine — sweat, cheese; repulsive — opium; nauseous — decaying matter; ethereal — fruits; and empyreumatic — tar,

characteristics some of which resemble those of one group and some of which are like those of another group. Consider as an illustration the ordinary tomato. The average person regards it as a vegetable. The scientist, however, usually considers it to be a fruit like the ordinary orange.

toast. According to Henning, olfactory properties may be classified under the heads of flowery, fruity, foul (spoiled egg), spicy (cloves), resinous (turpentine), and burnt. Some of these are quite similar to those of Zwaardemaker. Under these general heads, Henning placed many olfactory properties which vary more or less widely from each other. Within these groups fall many *thousands* of unlike odors.

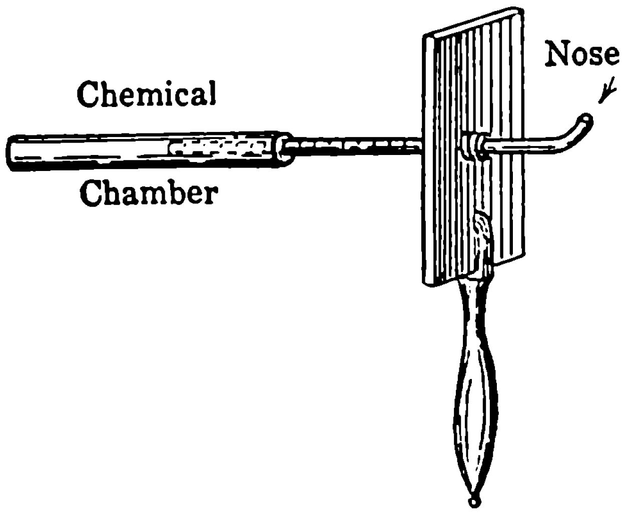

Fig. 43. The olfactometer. Used in studying olfactory functions.

b. Adaptation and Neutralization. The olfactory properties may be partially or completely reduced, either through adaptation or through neutralization by other properties. Of the first, every individual has firsthand knowledge. Even a reducing plant may quickly lose its nauseating odors. The writer is acquainted with a man who furnishes animals to such a plant. He is olfactorily indifferent, even at meal times, to his semiputrid cargo. Every hospital attendant recognizes the possibility of reducing undesirable odors by using other odors. The odor of carbolic acid, for example, can be used to *neutralize* the gangrenous odor which arises from decaying flesh. Creosote, too, will also destroy some other olfactory properties. Many odors, however, cannot apparently be neutralized. When two or more occur together they may produce an entirely new and possibly pleasing property. In these cases, the identity of each of the properties may be completely lost or submerged in the *emergent* property. The former properties may be completely unobservable. The art of synthetic perfumery attests to this fact.

D. *Explanation of Taste Properties*

a. Gustatory Sense-organs. The sense-organs of the gustatory properties are located chiefly on the tip, sides, and back of the tongue in the adult human being. Young children seem, however, to have them on other surfaces of the mouth. It has been suggested that more gustatory satisfaction may possibly be derived by the child through cramming its mouth quite full of food because more sense-organs are thereby simultaneously affected. The sense-organs ("tastebuds") commonly occur in the sides of the

papillae (see Fig. 44) which may easily be seen by an individual as red wart-like structures on his tongue. The end-organs are essentially hair-cells among which are located the tiny nerve fibers which lead to the brain. The end-organs are usually affected by substances in solution. Everyone has, no doubt, observed that hard objects placed in his mouth do not seem to be as quickly tasted as softer objects are. Rock candy furnishes a good illustration. The nature of the action of the stimulus upon the receptors is unknown. It may be partly chemical; yet we recognize that pressure, thermal, or electrical stimulation may possibly arouse gustatory properties. Various attempts have been made to discover a chemical basis of taste stimulation in the hope of relating the gustatory properties to definite chemical properties of the stimulus. There seems, however, to be no significant relationship here. Some chemical salts, for instance, taste salty; others cannot be tasted; and still others are bitter or sour. Some carbohydrates are sweet, but others are bitter.

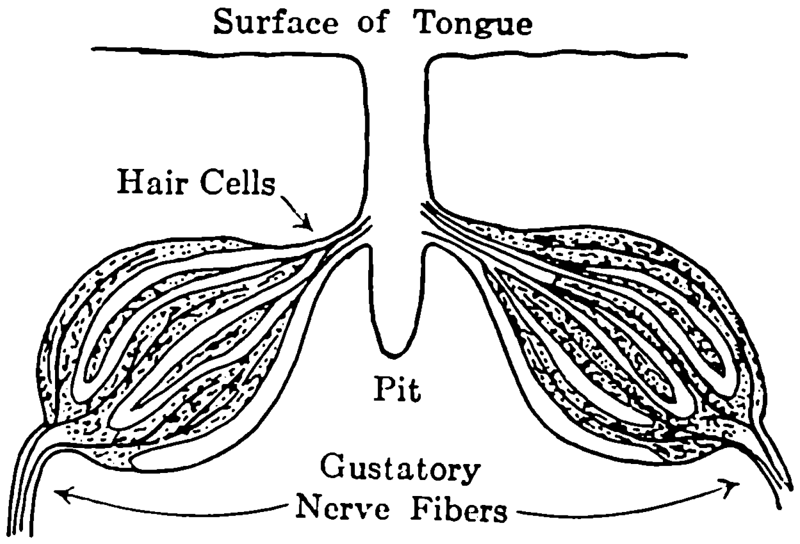

FIG. 44. Two taste buds with hair cells and nerve fibers.

Moreover, the problem concerning the total possible number of different kinds of taste structures remains unsettled. Is there but one type of structure for all properties, or are there many unlike structures corresponding roughly to the various kinds of properties? There may possibly be but one type of structure which becomes functionally aroused more quickly or more easily either in the same or in different regions of the tongue. Experimental data seem to indicate that some of these sense-organs are differently tuned so that they are affected differently by unlike stimuli or show differences in time required for activation. In terms of observed properties, they also seem to be grouped in certain areas over the tongue. Generally speaking, the sensitive structures on the tip of the tongue appear to be more directly involved in the perception of sweet objects, while those at the back of the tongue appear mainly to give the property of bitterness. The areas along the sides appear to involve sour perceptions; while the property of saltiness is perceptibly common to all areas. In many

cases, a single ordinary object may show one taste property at the tip of an individual's tongue, yet be perceived to have a different property at the back. While sodium sulphate, for instance, tastes salty at the tip, it is distinctly bitter at the base of the tongue. It should be understood that these facts hold true under *certain* conditions. Under large intensive changes or repeated stimulation, such gross divisions are inadequate. The student is reminded in this connection of the color functions of the periphery of the retina when the energy of the stimulus is considerably increased.

It is quite possible that certain organs can be raised to a functional level more quickly than others. It is recognized, in this connection, that the time required by the same individual to perceive different taste properties of objects or substances varies. The properties of sweetness and saltiness require about one-fourth second to appear; those of sourness take about six-tenths second, and those of bitterness need about one second to be observable. The functional effects of drugs upon these properties is interesting. When cocaine is placed upon certain papillae, bitterness is apparently the first to disappear or to be reduced. The other classes of properties are similarly affected in the order of sweet, and then sour. Salt is the last to be lost (if affected at all). Through one common *papilla*, many different taste properties may be perceived. Others may give the properties of only one, two, or three groups. The results of one study show that about 60 per cent of the papillae tested gave the properties of sweetness, bitterness, and sourness; about 12 per cent gave only sourness, and less than 5 per cent only sweetness. No one gave bitterness alone.

b. Nature of Stimulus. In general we can say that the gustatory stimuli (chemical energy) are neither as well known nor nearly as simple as in the case of the visual and auditory stimuli (physical energy). The stimulus here undoubtedly assumes the form of very complex chemical compounds. Generally speaking, it is quite impossible to establish any precise relationship between particular stimuli (chemical substances) on the one hand, and particular taste properties of objects on the other. In view of this lack of specificity, we find this point of interest; for we have definitely rejected the notion of a simple sensation being aroused by the action of some simple stimulus upon some simple receptor organ. Objects are tasted; not sensations.

E. *Explanation of Smell*

Sense-organs and Stimulus. The olfactory sense-organs, like all other similar structures, are microscopic in size. They are usually regarded as being hair-cells. At least, hair-like structures are found to extend slightly beyond the surface of the nasal membrane (see Fig. 45) in the region where the olfactory end-organs are assumed to lie. This area, usually less than the size of a nickel, is located in a tiny chamber quite out of the path commonly taken by air in passing to and from the lungs. While some air does continually reach it, a good strong sniff usually serves to bring much more chemically ladened air into this slightly isolated chamber and so into contact with the sensitive tissues, thereby affecting the individual's olfactory perception of objects. From the extremely small amount[1] of energy that is necessary to bring them to a functional level, and from the seeming ease with which adaptation may be induced in them, one may gather a better notion of the unusual degree of sensitivity apparently characteristic of these receptors or tissues. Although the organism is very sensitive to certain gaseous substances, it is wholly indifferent to many others. Some substances which are wholly harmless are perceptible, while others which are very deadly are not. The exact chemical basis in all such olfactory differences is as yet undetermined. Persons may sit in an automobile and breathe certain lethal gases from it without knowing anything about it. Since the canary is more susceptible than human beings to carbon monoxide, it is used in coal mines to warn the miner of his danger. Man is unable to smell many things.

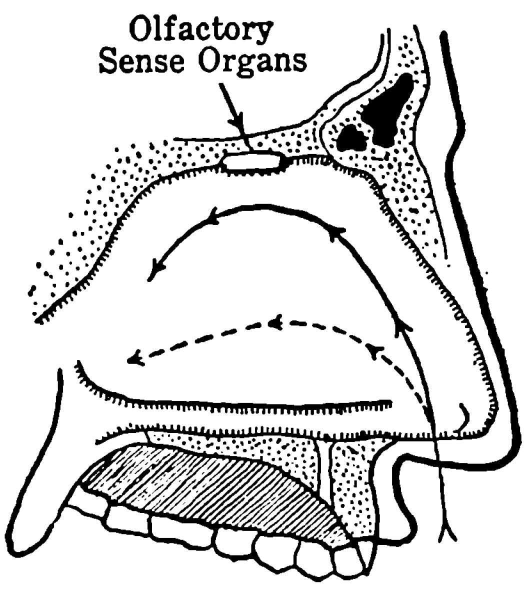

FIG. 45. Sketch showing region of the olfactory receptor organs.

Furthermore, some forms of pathological evidence indicate a possible difference in functional tuning. An individual who is partially anosmic may be unable to perceive some characteristics of objects without having his perceptions of other olfactory properties seriously affected. Some species of animal (birds), like a

[1] One liter (quart) of air containing 1/23,000,000 milligram of mercaptan will be distinctly perceived (Howell, p. 315).

small number of human beings, seem to be almost completely anosmic. Other kinds of animals, however, appear to possess extraordinarily keen olfactory perceptions. Many dogs, for instance, may be able to discover a particular stick, upon which some human being has momentarily placed his hands, even though it is later handled by other men who place it in a pile with many others which are visually like it. In all such cases there is no evidence that training ever increases the actual sensitivity of the animal's receptive organs. Whatever fundamental differences exist in this respect among animals must be undoubtedly referred to differences in constitution and in protoplasm.

All the evidence seems to point in the same direction: Tasting and smelling are very old ways in which organisms function. They extend historically beyond man's own racial development to a subhuman level. Life has indeed placed a heavy premium of a particular sort upon them. Lacking their guidance and protection, both men and animals would undoubtedly find it difficult, if not impossible at times, to survive. As we said earlier, these two functions seem largely to emphasize biological *utility* mainly at the expense of *appreciation*. Such functional properties of man are essentially practical.

OUTLINE

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CHAPTER VIII

CUTANEOUS, KINAESTHETIC, VESTIBULAR, AND ORGANIC PROPERTIES

III. CUTANEOUS

A. *Description*

a. The Nature of Cutaneous Properties. We have sought throughout to emphasize one point, *namely*, that the several observable properties of an individual's environmental objects are the immediate product of psychological functioning. Man is a dynamic living organism. Under the influence of his heredity, history, and physical environment he creates a psychological environment in which objects have many properties. From a physical and chemical mass of vibrant energy, he produces many things which may please or displease, satisfy or annoy him. The nature of these psychological properties varies with the particular mode (kind) of his functioning — some are seen, some are heard, some are tasted, and some are smelled. They are perceptual properties; that is, an object (or a part of his own body) is directly observed by an individual through his different senses to possess one or more of the various characteristics which we have thus far discussed. But our inventory of such functional or psychological products is incomplete; for the environmental objects of human beings are definitely qualified in still other ways. One of these functional ways is through touch. Historically regarded, this is, perhaps, the most primitive way whereby an organism sustains working relationships with the world around it. It has very great significance for normal as well as other individuals. Aside perhaps from olfaction, it is the primary highway over which all traffic between a deaf and blind individual and the non-food objects of his environment is carried.

b. An Illustration from the Blind. It was almost the sole way of Laura Bridgman, who was unable to see, hear, and smell objects.

Helen Keller, who is more widely known than Miss Bridgman, has written illuminatingly of her own uses of touch. She has reached a very high level of achievement as a result in part of the way in which she has been able to utilize her tactual perceptions. At the beginning of her formal education, she came to depend greatly upon the use of touch in securing information about the objects around her. Her teacher very early taught her so that she was able to communicate with her across a distance of several feet simply by tapping upon the floor. Miss Keller could tactually perceive the taps through her feet and understand the message almost as easily as a normal individual would hear or read. She has leaned heavily upon these properties in almost every phase of her life activities. "People have expressed surprise," she writes, "that I should notice any difference, except possibly the absence of pavements, between walking in city streets and in country roads. They forget that my whole body is alive to the conditions about me. The rumble and roar of the city smite the nerves of my face, and I feel the ceaseless tramp of an unseen multitude, and the dissonant clangor of machinery are all the more torturing to the nerves if one's attention is not diverted by the panorama that is always present in the noisy streets to people who can see."

c. **In the Normal Individual.** The normal person who is dependent upon visual and auditory properties for much of his guidance is usually inclined to make little use of the cutaneous properties beyond such ends as keeping himself comfortably warm, or cool, or free from pain. Because of this fact, he is often surprised at seeing blind individuals run their fingers over a mass of bumps on a piece of paper and read as rapidly as do many who possess full vision. The average normal-sighted individual is so uneducated with respect to his tactual properties that the variety of their uses among the blind frequently amazes him. His amazement here is not essentially different from that of the savage at seeing some person read a message from black marks on a piece of paper. The student should understand that training apparently does not significantly increase the tactual sensitivity of an individual. The valuable effects of cutaneous education appear in the proper *use* made of the tactual properties as aids to the organism in moving about, in communicating with others, and in maintaining an independent industrial or professional status. How far this sort of training may possibly go in the normal individual can

be seen in the machine-gun assembly drills where by blindfolding an individual it is possible to simulate actual conditions of night fighting. In such tests he takes his gun to pieces and then accurately assembles through touch the several pieces in an amazingly short time.

d. Kinds of Tactual Properties. Through his cutaneous perceptions, man finds that his environmental objects possess many properties in addition to the several varieties which we have previously discussed. Among other kinds, he finds his objects to be hot or cold, sharp or blunt, hard or soft, smooth or rough, dry or wet, slimy or sticky, moving or stationary, light or heavy. He also discovers that almost any object may be painful under certain intra-organic and extra-organic conditions. Each cutaneous property is itself irreducible to any other status. While one may bear resemblance to another, it cannot be analyzed to it. To point out similarities is not analysis. The nose of a son may be described as being quite like that of his father; but this is not analysis.

e. Some Factors upon Which Cutaneous or Dermal Properties Depend. The cutaneous properties depend, as do all other perceptual properties, upon a number of factors. The particular dermal characteristic of a perceived object may vary among other conditions (1) with the immediate history of an individual — with the temperature conditions of his skin, as well as the character and the degree of his previous stimulation; (2) with the nature of the perceived object; (3) with the nature of his training and preparation; (4) with the kind of stimulus and with the time of stimulation. Let us consider the first two. (1) If an individual's hands have been warmed or cooled, he may perceive water of medium temperature as being either cold or warm. There is a very simple and striking way of demonstrating this matter of cutaneous relativity. Take three bowls and place cold water in one, warm water in another, and mediumly warm or cold in the third. Then place the left hand in the cold water, and the right in the warm water. After a short time, place both hands in the water of the third bowl. Two clearly observable properties of this water will be simultaneously perceived.

Psychologically speaking, the water is actually both warm and cold. Physically speaking, the temperature of the water will be that single degree recorded upon a thermometer immersed in it. In the first case, two properties exist because the organism con-

tributes, as an historical being possessing definite functional properties, to the determination of the nature of the perceived object. Physically speaking, two unlike properties of this sort could not exist simultaneously in such a small body of water.

(2) A particular cutaneous property of an object may vary with the nature of the other properties of the object. We can give but one illustration here. Everyone knows that, while it may be rather difficult or wholly impossible for an individual to tickle himself, another individual may do it very easily. An illuminating aspect of another form of tickle concerns an assumed difference in tuning or in the functional level of the organism. In many cases, the energy of the stimulating conditions may be almost infinitesimal. A feather passed ever so lightly over the skin may instantly result in the appearance of tickle. In other cases considerably more force must be brought to bear in order for the tickle properties to be observable. When they do appear, they may be quite different from other related forms.

f. The Properties of Coldness and Warmth. If a fairly sharp pointed metal rod, which is somewhat cooler than the temperature of the cutaneous area which is to be studied, is moved slowly over the skin of an individual, the latter will find at times that the object is perceived to be clearly cold. If the same rod is warmed slightly above the temperature of the experimental area and is then passed lightly over the skin, it will be perceived at certain spots to be clearly warm. By this method, a student may determine the various places within a particular region of the human body where an object is perceived to be warm or cold. If he returns later to the same region, he will find that these spots are not definitely fixed; they shift slightly from one test period to another. This fact has led some students to hold that any particular "spotted" arrangement which may be secured at one period of experimental testing is to be attributed to temporary differences in the physiological mechanisms of the skin. Some are momentarily more active than others; then there is a shift in the functional level.[1] Those which were less active become more active.

[1] If the student will stare fixedly at a mosaic of small objects, such as may be found on a tiled wall, he will see that at one moment certain squares are much *whiter* than others. At the next moment, however, he will see that others are *whiter*. There is a continuous *shift* in the visual properties of these objects although the physical energy may remain constant. *The retinal functions apparently rise and fall from moment to moment.* This is even more strikingly shown by using some pattern

Experimental data appear in part to sustain this point. In a particular area in which there is mild erythema (redness as in blushing and under other conditions) every portion of the skin is seemingly responsive to stimulation by a warm object (Starling). That is to say, the property of warmth may be perceived at every point; the organism now seems capable of observing heat through *all*

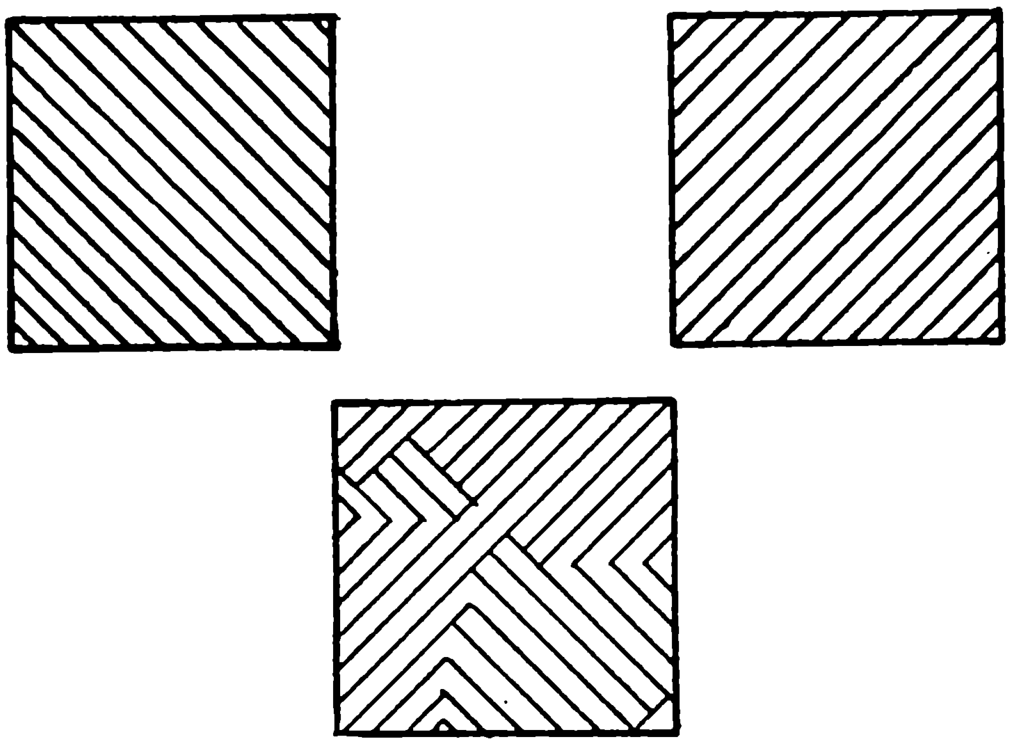

Fig. 46. Stare through and beyond upper two patterns to observe pattern in which there are rapid shifts.

parts of the skin. The spotted arrangement obtained under *other* conditions is clearly gone. The functional level of all the sensitive structures in the area of erythema is definitely raised; the skin is now uniformly sensitive.

Although the perceptions of the warmth and the cold properties of objects vary with the temperature of the skin, we find a rather narrow range extending from 27° to 32° C. in which the greatest degree of thermal perceptibility apparently exists. That is to say, between these limits, a very slight change (perhaps as small as $\frac{1}{25}$ degree) in the physical condition of an object may be accompanied by a change in psychological property. Below this lower limit for perhaps 15° more, coldness may be perceived before pain properties are also perceptible. Above this upper limit for perhaps 20° more, warmth may be experienced before pain becomes observable. Here is a range of about 40° in which warmth and coldness seem to appear somewhat independently of other cutaneous properties.

like that shown in Fig. 46. When viewed in a stereoscope, the resulting lower object is seen in constant fluctuation — the lines run now one way, now another way.

g. A Story by Scott. When some object, which has been warmed to a temperature between 40°–60° C., comes into contact with the skin of a human being, it may be perceived as being *cold* although its temperature may actually be considerably higher than that of the skin. Because it is so different from what one "logically" expects from an understanding of the physical property of the stimulus, this psychological property is known as paradoxical cold. Since this property appears under these conditions, it may account for the fact that some warm substance, such as water, may be momentarily perceived as being cold.

Another experience somewhat opposite to this may also be observed upon touching metal that is extremely cold. The object may be experienced as being burning hot. Scott tells this story about an experience of his while waiting to make that tragic dash to the South Pole. "On our small heating stove stands a cylindrical ice melter which keeps up the supply of water necessary for the dark room and other instruments. This iron container naturally becomes warm if not fed with ice, and it is generally hung around with socks and mitts. I put my hand on this vessel and withdrew it sharply with the feeling of heat. To verify the impression, I repeated the action two times, when it became so strong that I loudly warned the owners of the socks of the peril of burning. Upon this Meares said, 'But they filled the melter with ice.' And upon coming over to feel the surface, added, 'Why, it's cold, sir.' And indeed it was." When two sources, one of which is cold and the other is warm, are simultaneously applied to a given area, an individual apparently does not perceive either coldness or warmth. He perceives, instead, that the object is hot. In terms of its simplicity, this property is quite comparable either with that of the beating sound which is observable, as we have said, when two sound waves simultaneously affect the organism, or with that of depth (where two different views are obtained by the two eyes) when an individual looks into the stereoscope.

h. The Family of Pain Properties. If an object of the same temperature of the skin comes in contact with the organism, it may be perceived merely as being painful. It may be neither warm nor cold. While students commonly speak of the experience of pain, there is really a very large *family* of pains, among the various members of which are those commonly known as throbbing, burning, itching, sharp, dull, stinging, and tingling. Since the

perception of pain is biologically important for survival, it is not at all surprising to find almost every region of the body mediating this property regardless of the particular mode or kind of physical energy (thermal, mechanical, chemical, electrical) that serves as a stimulus. Parts of the body (internal) may at times be cut without pain yet a slight pull or stretch of the same tissues will produce intense pain. At other times, almost any form of stimulation may be very painful. The sudden flow of blood into a part of the body (arm) that has "gone to sleep" will cause it to ache. If a very cold object, for example, is placed against the skin, it will be clearly perceived to be painful. Or, if a very hot object comes in contact with the organism, it, too, is definitely perceived to be painful. In the usual cases of mild erythema, a *warm* stimulus source instead of being observed in a normal manner — as being warm — is actually perceived to be quite painful.

In every case, the *pain* apparently arise. in part, from the functioning of certain sensitive structures, which may quite possibly be the same structures which are involved under other conditions in the perceptions of warmth and of coldness. Or, if any object pricks, pulls, shocks, burns, cuts, or pushes the organism, it may instantly be perceived to be painful. After such an object has been removed, the individual may continue to perceive the previously stimulated region of his body to be painful. Normally, the painful object must be something, theoretically speaking, that apparently has an immediately injurious effect upon the organism, or a part of it. The student should realize, however, the impossibility of defining a painful thing apart from how the organism actually functions. A thing may not necessarily be harmful at all in a biological sense, yet it may be extremely painful. Many know how very painful a tooth may be even when it has but a very tiny cavity in it. Some injurious things are painful, but others are not (X-ray). One is necessarily guided at all times by what discovery brings. If every ordinary object were always to affect the organism in a painful manner, life would be utterly unbearable. Generally speaking, the organism is definitely equipped in one way for trafficking with environmental objects of a non-injurious nature and in another way for those which are harmful.

i. Other Properties: Roughness, Size, and Shape. Instead of a painful object, an individual may observe other psychological characteristics of objects. He may perceive objects to be heavy

or light, sharp or blunt, round or square, rough or smooth, wet or dry, moving or non-moving. These various properties which are cutaneously observed in an object by a functioning organism may be relatively independent of the other properties such as warmth, coldness, and pain. As we have previously said, properties usually occur together and thereby characterize some one object. One object may be cold, rough, dry, and painful; another may be smooth, wet, and non-painful. The non-painful, non-temperature properties which in part characterize many objects should be regarded as constituting a large *family* of pressure properties. Thus we recognize that an individual does not necessarily observe some meaning in addition to roughness, hardness, movement, and the like unless he classifies a thing — gives it a total object-meaning. Each source upon coming in contact with the human organism may be perceived as having one or more of such properties as we have mentioned here.[1] It should be noted that, within limits, an object tactually perceived usually has size (extent) and, provided it does not extend beyond the boundaries of the skin (when laid upon it), it may have shape. Each characteristic or property appears quite immediately — an individual does not at first experience sensations without size and shape and then at a moment later observe the size or shape of an object. It is true that he may possibly disregard the size and observe only the shape. What he observes (experiences) depends in part upon his history and his instruction. If an object is not perceived in terms of its shape, weight, size, dryness, or roughness, an individual may possibly observe only temperature. All these psychological properties, we say, are immediately perceived. While we cannot actually deny that visual images, for example, may be necessary, as some would claim, for an organism to perceive a property, such as roughness, they certainly are not *observable*. As long as he sticks closely to *observation* and is not misled by theory, an individual will find that these various cutaneous properties of objects are instantaneously perceived. They are *not* derived from non-perceptual items. Things may, we say, be directly perceived in terms of how they feel.

j. Sharpness, Smoothness, Movement. A small object (not necessarily painful) may be tactually perceived as being sharp.

[1] When a single hair is brushed, one merely perceives that some object is moving or has moved over the skin, or is on a certain area of the skin.

That is, sharpness (of a pin) and thinness (of a blade) are irreducible, observable characteristics of objects. Smoothness appears where a continuous uniform surface-pattern is experienced. This is true when the hand is passed over an object, when an object rests upon the skin, when a stick held in the hand is rubbed over an object, or when an object is rubbed over the end of a stick as in the case of a walking stick held against a rapidly driven machine belt. Moreover, when a toothed wheel is rolled lightly over the skin, touching it somewhat in this manner - - - - - - - - - - - - -, an individual instantly observes an object in movement — not discrete successive positions of a sharp or dull object. The wheel may be either painfully warm or very cold without affecting the property of movement. While very slight *changes of a physical* sort do not affect tactual properties as much as they do visual properties, a surprisingly small physical change may produce a change in what one tactually observes in his environment.

k. Locality and Discrimination of Objects. The degree of accuracy of tactual localization and discrimination of objects varies, other things equal, with the particular area of the bodily surface that is experimentally studied or functionally involved. If a sharp point is pressed lightly upon the upper arm of a blindfolded individual and he is then asked to localize it by pointing, he will not come very close to it. If we represent his ability to make this localization by the numeral 1, his localization at his fingertip would be many (15) times better. Data upon the localization *without vision* of the place touched by a sharp object pressed momentarily upon the under surface of the wrist, show an average error of about 13 millimeters. When the observer is permitted, however, to see the place on his arm while it is being touched, the average error is reduced about 50 per cent. The use of vision accordingly increases the accuracy of tactual localization even though it is not directly employed at the actual moment of localization.

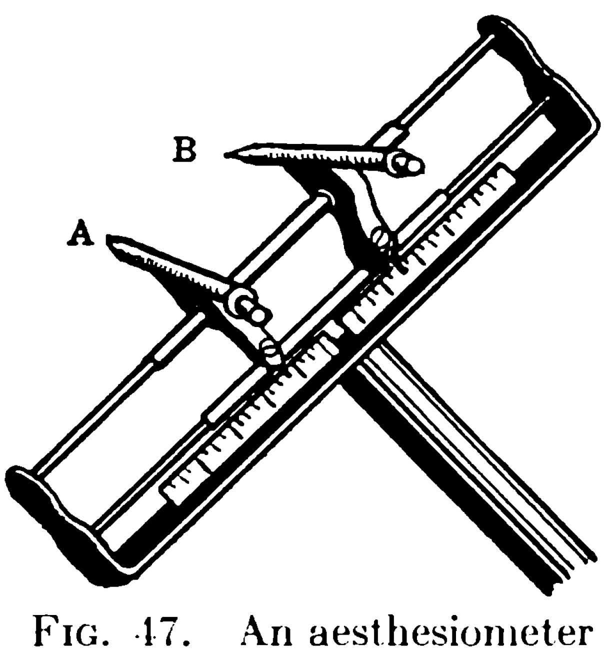

FIG. 47. An aesthesiometer (used in tactual studies).

The discrimination of two objects brought simultaneously in contact with the skin (Fig. 47) varies considerably at different regions of the body. On the tip of the tongue, for instance, a

spatial separation of 1 mm. results in the perception of two different objects. We can better understand then why an individual can perceive such tiny objects (holes, etc.) with his tongue. A spatial separation of about 10 mm. is apparently necessary in order for an individual to perceive two different objects on his palm. Other regions and the amount of separation necessary to induce a discrimination are approximately as follows: Forehead — 25 mm., back of hand — 30 mm., middle of back — 65 mm. Over various areas, the amount of separation necessary for two objects to be clearly perceived varies also with the direction in which the two objects — aesthesiometer — is applied. When the testing instrument is placed, for example, *across* the under surface of the arm a short distance above the wrist, the spatial separation must be around 20 mm. in order for two stimulus-objects to be perceived. When placed the *long way* of the arm in the same region, however, the spatial separation must be increased about 50 per cent, that is, to about 30 mm. (see Fig. 48). Physiologically speaking, essentially the same nerves are involved in both cases. But the functional products are quite different.

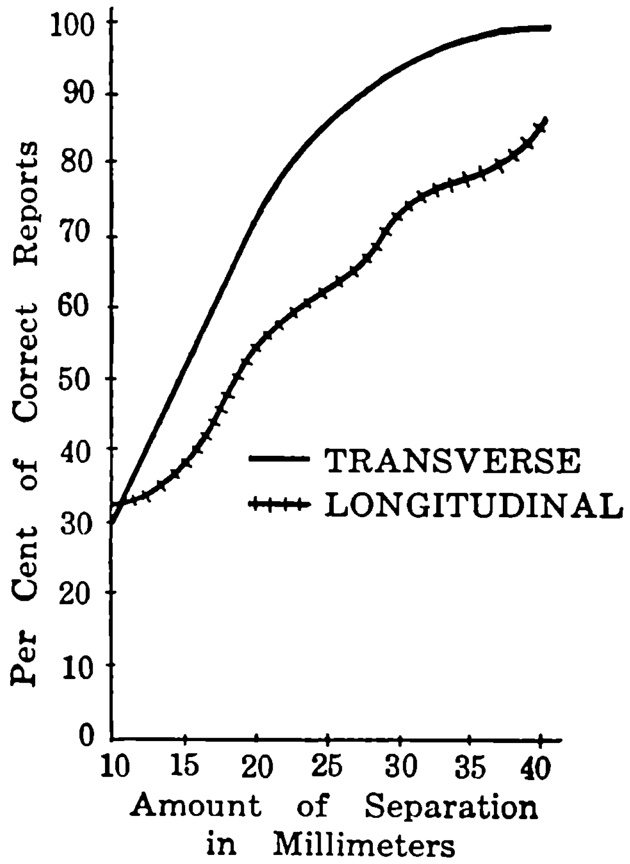

Fig. 48. The mode of stimulation affects the nature of functional product.

1. **Changes in Cutaneous Properties under Adaptation.** Adaptation, or the effect of an individual's history upon his activities, is shown in a striking manner in connection with the tactual properties of pressure, warmth, and coldness. An individual rapidly becomes indifferent to many objects (stimulus remaining constant) which press against his skin, as well as his shoes, his clothing, and his false teeth. In the same way, he very shortly becomes unable to observe tactually the previously too warm or too cold room. Properties which at first were there may cease to exist, while other properties which at first were lacking may later appear. Time brings changes. But such changes hold true, curiously enough, only within certain determinable limits. An individual does not become so completely indifferent, for instance, either to a zero or

to a torrid climate that he is no longer able to observe its properties. Above all, he is not normally able to prevent the perception of painful objects. Pain is clearly one psychological property which is obviously incapable of being reduced, or disregarded, to anything approaching the degree to be found in many other properties such as color, taste, odor, and pressure. Because some painful environmental object, or a part of his body, serves as a constant psychological prod to action, an individual endeavors to rid himself of it — whether it be a boil, a tumor, a jagged tooth, or a nail in the shoe. Biologically speaking, man's pressure, gustatory, and olfactory perceptions may not possess as much significance as do his temperature and pain perceptions. He can seemingly get along with less danger to himself without the former than he can without the latter.

B. *Explanation*

a. Sense-organs. No sense-organs comparable in degree of specialization with those, for example, of vision have been found in the skin to account in part for the perception of the various cutaneous properties of objects. We are sure of the psychological properties; but not certain of causal or explanatory conditions. The anatomical evidence concerning the nature of possible receptor organs for warm, cold, pain, and pressure is ambiguous. It is apparently impossible to correlate a particular cutaneous property with a particular type of sense-organ. Dallenbach, for instance, carefully located certain skin areas through the direct stimulation of which he observed the properties of warmth and coldness. These areas were carefully removed by a surgeon and expertly examined with regard to the possible presence of *unlike* receptor organs and undifferentiated nerve-endings. But not a single specialized end-organ was found. Free nerve-endings were again shown to occur in very great numbers under the epidermis. We assume, therefore, that such free nerve-endings function together with the brain to produce each tactual property. There is one type of structure, but it serves many offices. The significant differences are not anatomical but psychological. Function — not structure — is really important here.

b. Functional Evidence of Receptors. Most students are seemingly inclined to hold that these more or less unspecialized structures may mediate not only thermal but also pain and pressure

properties. From this position, the very gradual shading from pressure properties into pain, or of warmth or coldness into pain, becomes more understandable. It may very well be that different stimuli (thermal, injurious, etc.) actually tend to produce different levels of functioning in these non-specialized structures. Cold, which in physical terms is absence of heat, accordingly appears to be perceived more quickly than either warmth or pain. Pain is normally the slowest to be perceived. The difference between the physiological conditions of temperature and pain, for example, would be referred in terms of the above explanation to a difference in the degree or rate of activity or what we have previously referred to as the functional level of the same organs. Let us note, however, in this connection that tests show that an individual may possibly lose some pain properties (analgesia) without at the same time losing temperature properties. But the present state of knowledge about all such particular abnormal losses is so very meager that such differences may not be significant.

Some tactual properties may result from the functioning of free nerve-endings that twine around hair follicles. Physical pressure applied to the hairs may raise the functional level of such sensory endings. The student can observe one type of these properties by touching his pencil to a hair on his arm. A cutaneous property is instantaneously perceived in this case. The removal of the surface hairs affects these properties. On some unshaved areas an object of a weight of less than two milligrams will normally be perceived. But on a shaved surface an object must have a weight from ten to twenty times greater in order to be perceived. In general, we can say at the present time that careful anatomical studies have not revealed the presence of unlike sensory *structures* which might possibly account for each of the different psychological properties observable in tactually perceived objects. Until such definite and specialized structures have been discovered, we assume that it is much better for descriptive and explanatory purposes to hold to some difference in the manner in which the many millions of free nerve-endings of the skin function under different conditions. It is at least impossible to state factually that different end-organs for these properties have been discovered. The stimuli may differ and the psychological properties may differ, but the receptor organs may be the same. A property of an object may completely change while the sole change in the energy conditions may be an increase

in intensity. If the student will press gently on his hand he will observe one kind of object, but if he will press intensely he will observe another kind. A non-painful object may thus become a painful object.

The evidence in support of the assumption of specialized structures is put partly in terms of time. In some cases, as we have said, the evidence is derived from the difference in the time required for the arousal of two kinds of properties. In other cases, the evidence is drawn from pathology. For example, when a nerve which leads to a particular skin area is cut there may be a difference in the order of the appearance of perceptual properties, as well as in the actual amount of physical energy necessary to induce a functional condition.

The experimental results, as Waterston suggests, seemingly point toward differences in the *physiological activity of some single mechanism.* There is but one structure, which functions differently under different conditions. This means that the stimuli for the tactual perception of objects actually take several forms — thermal, electrical, mechanical, and chemical. Each general class of these stimuli affects the nerve fibers in an unknown manner. Moreover, the several possible conditions of the total organism — what it has previously done (adaptation), its expectation, and its momentary state (temperature) — serve to determine to a very great extent the nature of what is perceived at any given moment.

c. Brain and Cord. Most students sensibly emphasize the importance of the brain and the spinal cord as determining conditions of tactual properties. They hold that while the same structure in the skin may be concerned in the production of the several cutaneous properties, there are different neural functions which involve the spinal cord and the brain. We can say, in general, that stimulus, sense-organs, nervous system, and psychological product are inseparably related. Each represents but a *single phase in a continuous whole.* There is no break from one end, to the other. Each plays a part in the whole causal and resultant series.

d. Inherent Determination. It appears that the psychological projection of cutaneous properties into environmental objects or into various regions of the human body rests, just as in vision and in audition, upon an *inherent functional property* of the living organism. This is, indeed, a very fundamental assumption. It

really serves as a broad foundation for an adequate approach to the field of psychology. Upon it we base much of our understanding of psychology. We accordingly hold that the human organism shows many unlike functions. One large class or kind of these functions — *namely*, psychological — is to be known or differentiated from all other kinds by the nature of its observable products. They are always meaningful. Such functional products are the observed properties of a certain object or situation under certain conditions. Each product is a unique and integral characteristic. It cannot be separated from the thing without a resulting change in object meaning. It actually constitutes, as far as it goes, a particular thing. It is not an independent part of a thing, no more than the seat or the leg is an independent *part* of a chair. A rock, for instance, may be cold or it may be hot. In either case, the perceived temperature is, at any given moment, an inseparable characteristic of the object — as much in fact as its size or shape. Size, shape, and temperature will always be observed under certain conditions.

Some forms of pathological evidence bear rather strikingly upon this matter of psychological projection. An individual with the stub of an amputated arm or leg may be acutely tormented by that which he no longer possesses *in the flesh*. A number of years ago, a friend of the writer lost one arm. Over a long period, he would occasionally remark that the fingers of his lost hand were cramped. He said also, at times, that he knew he would feel much better if he could only find a way to straighten them. In this case, he actually observed, where his arm had been, the very clear properties of a cramped, painful hand and fingers. Physically speaking, they were gone. But psychologically speaking, they were at times present. And much of his perception, thought, and action was definitely determined at times by the pain in his hand. It is well known that men who are suddenly seized with the intense pain that occasionally appears in such a missing member may momentarily abandon whatever they may be doing and grab quickly at it.

In many such cases, the slow changes of repair and growth — healing — of the arm and the nerve stubs may possibly be the immediate physiological condition or factor that initiates and maintains such functions. In other cases, however, the conditions exist wholly within the brain. But neither in these nor in those

other well-known cases where the "funny bone feeling" may be clearly observed in the hand is any *specialized end-organ* stimulated. In either case, however, the intense pain or the unpleasant tingling is a perceived property of the hand and the fingers (although one may observe at the same time the hand pressing upon his arm). The extent to which this sort of perceptual "projection" of tactual properties may normally be carried is again shown in the case of the skillful surgeon who may unseeingly probe with his instruments in the hidden recesses of the organism and seemingly perceive almost as expertly as he would if he were directly using his fingers. In such experiences, contact with the object is apparently at the farther end of the probe regardless of the particular manner in which the other end of the probe is held in the hand.

The tactual perceptions of localization, discrimination, movement, size, shape, etc., must be regarded in part as being a result of functional predispositions established in the individual through his racial history. These functions are extremely useful ways of dealing with various environmental objects. An organism lacking in such ways of trafficking with its surroundings would unquestionably be placed at a very serious disadvantage in its life activities. Concerning inherent determination of tactual localization, we know that a dog, for example, is able to place one of its feet approximately upon a stimulated spot on its abdomen; and even a frog with its spinal cord completely severed from its brain may lift a hind leg and brush at a place on its side or its fore-leg where a drop of acid has been placed. We assume, too, that man's nervous organization which he possesses by virtue of his long history normally enables him cutaneously to localize objects approximately as well as a dog or a frog does. The week-old human infant, for instance, will shift one leg and push with its foot against an object upon the other leg.

e. **Can the Object Properties of One Psychological Function Be Derived from Another Function?** Some students have, at times, sought to explain the facts of cutaneous localization by regarding this ability as being derived, for instance, from the visual functions. No reliable data, however, have ever been advanced in adequate support of such a position. To shift from tactual to visual functions gives little understanding of the former. At best, it merely removes the matter one step — for the problem then concerns the

way in which a human being or an animal is able to localize through vision. The retina of the eye itself is actually spread out, as far as stimulation is concerned, in quite the same manner as the skin. We must also recognize, in this connection, the nature of some data obtained from studies of cutaneous functions of immature and of blind individuals. According to the experimental data, normal children seem to be able to localize objects upon their skin at least as well as normal adults do. At the adult level, blind individuals equal or excel the non-blind in this sort of perception. Stratton has pointed out that the partially blind are better than the normal sighted while the totally blind excel the partially blind. Figure 49 shows some experimental results obtained from normal and blind individuals who were asked on successive days to localize by pointing the exact area previously touched by a sharp object. It also shows some of the effects produced through repeated observations (26).

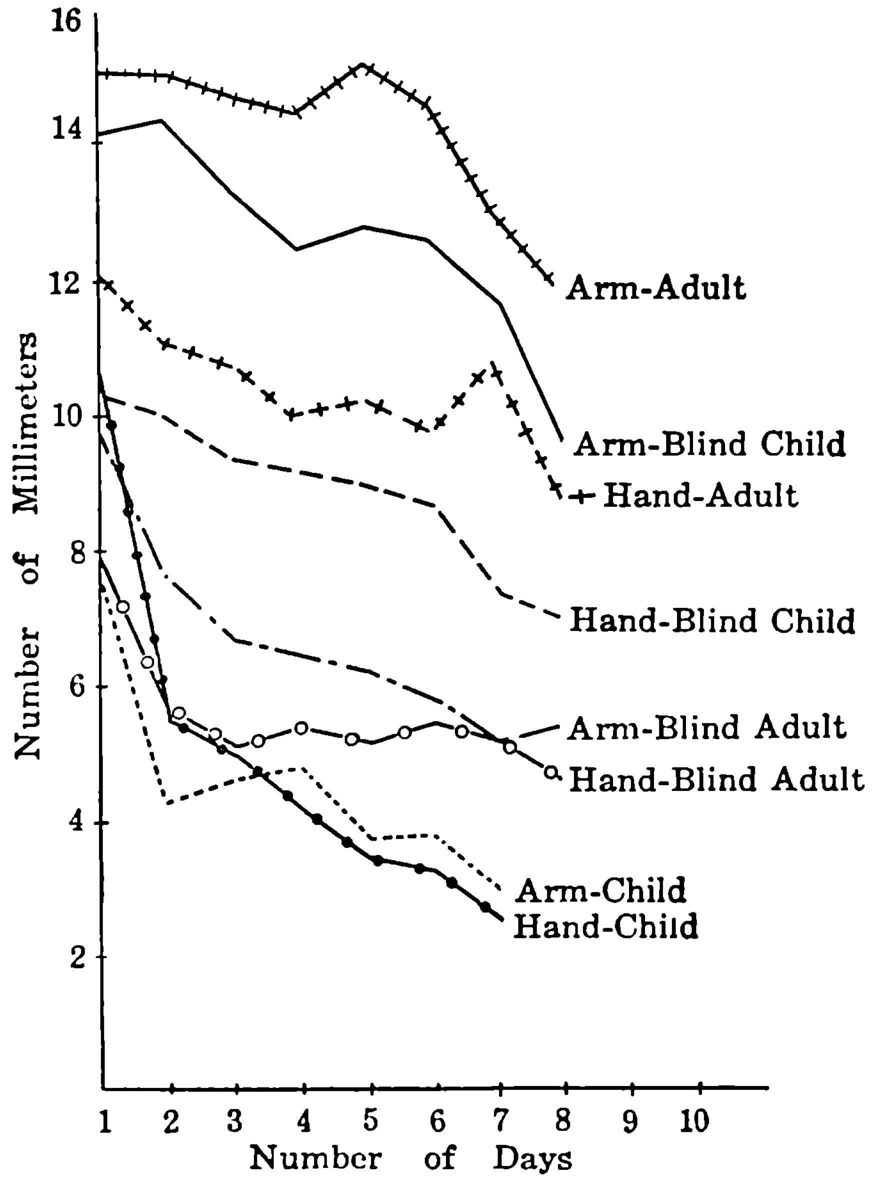

Fig. 49. Do the blind excel the non-blind in tactual localization?

The evidence points, in its various forms, to an inherent determination of such functional properties of man. The introduction of another function, such as vision, into a situation in which only one function, such as touch, was previously involved should naturally result in a change in what the organism does, that is, a change in the product. But this does not prove, in any sense, that the products of the one function are *derived from the other function.* The introduction of an additional causal factor into a situation may serve as a determining agent. A proper recognition of this fact is quite necessary for an adequate understanding of the differences to be found from time to time among the various psycho-

logical products. Again, when one of two or more functions is withdrawn from a total situation, the organism is usually able to carry on. But what it then does will normally be different, however, from what it did under other conditions. That individuals who have been blind from birth may accurately localize tactual objects is evidence in support of the relative independence of cutaneous and visual functions.

IV Bodily State, Position, and Movement

A. *Kinaesthetic Functions and Properties*

a. Position and Movement. The psychological properties of vision, audition, taste, smell, and touch are widely characteristic of an organism's environmental objects. For example, I hear and I also see the red bird which is sitting on the short limb of the small tree across the street. I also taste, smell, and feel the candy which I place in my mouth. In such cases, the observed properties are not characteristics of a human organism — myself — but of the perceived bird or of the candy. But I also observe, as I seek further illustrations, that my fingers are very tired, that my back is badly cramped and that my neck aches when I turn. In these cases, we come upon psychological properties which are observed to be characteristic of, or to pertain to, different *regions of the organism.* In most portions of the human organism, save the nervous system itself, certain psychological properties may be directly observed under certain conditions at different times. The nervous system which is essentially the functioning structure within the organism that makes possible the thousands of unlike meanings or properties is itself apparently lacking in all such properties. It perceptually refers beyond itself but not to itself. We never *observe*, under any conditions, that our nervous system is, for instance, sore or tired. A man may actually have a serious brain tumor and know nothing about it. The symptoms in this case will be functional — he may be partly paralyzed, or blind; or he may be unable to remember or imagine as he formerly did.

The human organism may operate or function in quite the same manner in perceiving a "part" of itself as it does when perceiving an extra-organic object. New or peculiar functions are not necessarily involved when man turns from his world of environmental objects to his own parts and appendages. Such things are also

outside his nervous system. A proper understanding of our discussion involves the recognition of this truth. An individual can place one hand against the other and observe its roughness, wetness, hardness, size, and shape just as quickly, as immediately, and in the same functional manner as he does when he places his hand upon an environmental object. The several properties in the former case simply qualify the individual. There is the additional meaning, of course, of its being the hand of the individual. We recognize, moreover, that a human being may actually perceive the position or the movement of his own legs somewhat to the same degree, although not necessarily in the same way, that he does the legs of his friend. He may *see* his friend's legs with whom he may be walking and *feel* his own to be moving in step with those of his friend. In some forms of nervous disturbance or injury (broken back), he may be able to perceive the position and the movement of his own legs only through the use of his vision. When his eyes are closed he cannot state either their place or their position. We are interested here in one of man's functional ways of dealing directly with the psychological properties of his own organism.

Under normal conditions, the many positions of his body and his limbs, as well as the direction, the rate, and the extent of many movements, can be immediately perceived by the individual. These several unlike meanings issue directly through kinaesthetic perceptions. Such perceptions constitute one class or kind of functional property of man. As ways of functioning, they are quite distinct from the other forms which we have previously considered. They are as distinct, if we may cite an analogy, as the thirst-quenching property of water is from its property of specific gravity. It should be obvious that these perceptions are inestimably valuable to the organism. In those occasional cases in which they are lacking or impaired, the individual necessarily depends upon his vision or audition for any reference or guidance which he may have concerning such matters as the position and the movement of his arms and legs. In *locomotor ataxia*, for instance, as a direct result of the loss of his kinaesthetic properties, an individual, in order to walk, has either to see or hear his feet. If he cannot see, as in darkness, or if he cannot hear, he is unable to walk. He can move his legs but he does not know where they are. To move about at night such a person must necessarily carry a light or slap his feet. When a like disturbance affects the use

of his hands and arms, an individual immediately tends to drop any object he may be holding if he is momentarily distracted or if he happens to perceive some other thing. He is quite like the normal individual who may "thoughtlessly" release a very important object which he may be handling or holding when he suddenly faces a very unusual situation.

b. Fatigue, Strain, and Pain. A human being also perceives kinaesthetically such psychological properties of himself as fatigue, strain, and pain. When he is fatigued, he usually observes that his arms and legs have actually become very heavy and that they cannot be moved as readily and as easily as when he is rested. He observes, moreover, the increased effort and strain involved in maintaining an erect posture or in carrying a load. He wishes to rest. He finds increasing difficulty in continuing whatever task he has to do. He is no longer able to function — perceive, imagine, think — as efficiently as previously. He may be forced to read or hear something several times before he understands it. Situations — objects — take on new meanings or lose old meanings. In short, he behaves differently. Scott wrote in his journal of an incident that occurred during the return trip from the South Pole. He had turned back to aid one of his men who through exhaustion had fallen in the snow. Scott gently encouraged him to get up and continue with the rest of the party. But the man, kneeling in the snow, stared stupidly at Scott without understanding what he was saying.

Neither precise stimulus conditions (physical and chemical energy) nor receptive structures which are sufficient to account for fatigue have ever been discovered. That is, no adequate description of fatigue has ever been given in terms of such factors as physico-chemical energy (stimulus) and specialized fatigue sense-organs. It is a psychological property which unquestionably appears at times in human beings. It is an inherent characteristic of life that clearly emerges under various conditions — some of which are better understood than others. The presence in the body of certain products of the metabolic functions, such as carbon dioxide and lactic acid, may be shown in certain cases of fatigue. These may possibly serve, in some manner, as stimulus conditions. But particular or specialized end-organs which such substances might possibly affect to produce fatigue *have not been isolated.* Perhaps there are no such structures and perhaps there is no

stimulus, in the sense of some form of physical and chemical energy which is *distinct* and separate from the organism. Fatigue may possibly arise as a direct result of a change in the normal mode in which protoplasm functions. An increase or a decrease in some one necessary substance or condition, thereby disturbing the innately determined life balance within the protoplasm itself, may be wholly sufficient.

In this connection, we must not neglect the experimental evidence derived from studies of certain functions of muscle tissues which have been removed from the body and electrically stimulated. The data indicate under such conditions that fatigue is possibly due more to *physical* than to *chemical* causes. This is to say that muscle tissue which has ceased to function — contract — after a prolonged period of functioning may be immediately restored to a functional condition by being washed in a saline solution. It is quite like saying that the fuel in a stove cannot burn so strongly when the ashes of previous burning have accumulated.

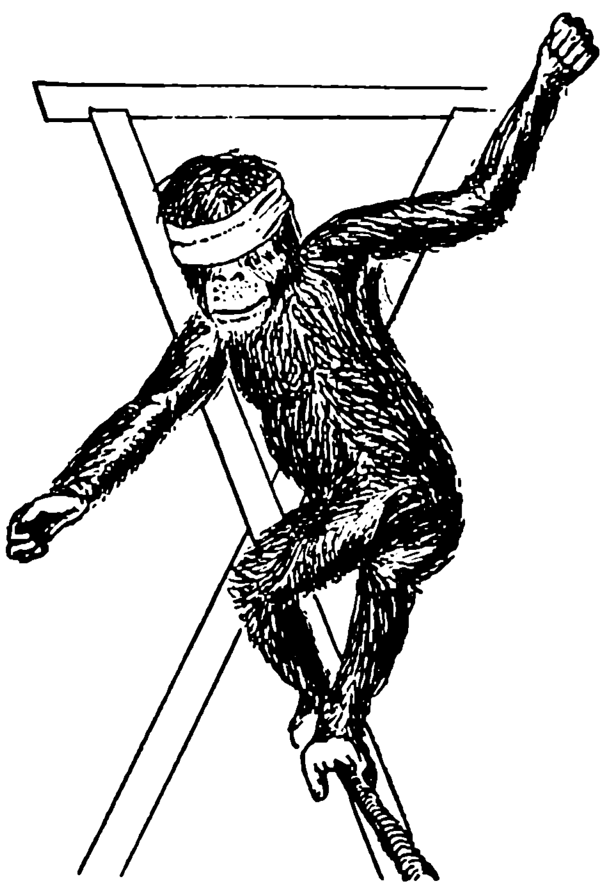

FIG. 50. Sketched from a young apish exhibition of balancing.

We must recognize, of course, when we speak of fatigue in an isolated muscle, that we are definitely in the field of physiology. Whether the perception of fatigue, which is psychological, depends upon conditions identical with those of the isolated muscle or upon other causal conditions remains an open question.

The observable weariness that characterizes fatigue may be a property of the whole organism. It is as much a part of fatigue as the general lowering of the efficiency of the whole organism. The student must recognize, furthermore, that both the weariness as well as the inability to function efficiently may occur in the complete absence of such substances as lactic acid and carbon dioxide. In such cases, the individual may be very weary and unable to do much, but there is nothing discoverably wrong with his muscles. Chemical tests, moreover, do not show the presence of waste products in the blood stream. The primary cause in such cases

is to be referred again to the nervous system (brain) of the individual. We suggest that all normal fatigue is really due largely to a neural condition. It is based primarily upon a change (decrease) in the functional level of the central nervous system. When emergencies appear, the individual may actually rise instantly to a new functional level. *Pain:* Again, an individual may remember for a long time the sudden cramping of his leg, or arm, or stomach that leaves him gasping with intense pain. A muscle may be so tightly contracted in cramping that it literally ruptures its enveloping sheath and protrudes into the surrounding tissue. In these cases, an operation is usually necessary if permanent impairment and continued pain are to be prevented. Here also no specialized end-organs for such pain properties have ever been isolated. It is quite possible that the same structures which function in part to produce the meanings of position, movement, etc., also produce pain.

c. Rôle of Kinaesthetic Properties in Action Patterns. Wherever the activities of the muscles and the joints of an individual are concerned, kinaesthetic properties may appear. They furnish in part the necessary psychological foundations upon which human beings build a great many of their skilled patterns — both recreational and industrial. The athlete, we say, is successfully carried along partly by means of his kinaesthetic perceptions. The expert typist builds her integration of movements in part upon the basis of kinaesthetic properties. In the latter case, vision is certainly not necessary, since the blind often become quite skillful in this field. They also use cutaneous properties, of course, but mainly to keep their fingers properly placed upon the keys, that is, to localize various objects.

d. Other Properties. In addition to these various observable properties of an organism which in part guide and sustain it in what it does at any given moment, kinaesthetic perception also gives man a variety of meanings about the weight, distance, roughness, smoothness, shape, and size of his environmental objects. By passing his fingers over an object, an individual may kinaesthetically perceive it in terms of its various characteristics. Under certain conditions in which his skin is made non-functional either by a disease or an anaesthetic, these several properties of objects may still be clearly observed. The tactual properties may thus disappear while the kinaesthetic remain. They constitute one kind of functional product of the human organism.

e. Explanation: Anatomy, Physiology, and Physics. It is assumed that whatever *nerve-endings* exist, as the receptor basis of properties, must occur in the muscles and possibly in the tendons and in the membranes covering the joints. We know, perhaps, no more about the anatomy and physiology of the structures concerned in the production of these properties than we do about those involved in the cutaneous properties. The evidence points toward the functioning of undifferentiated (non-specialized) structures in the muscles and perhaps in the tendons and in the joints. The student should realize that these psychological properties, regardless of bodily basis, differ from those which appear through vision and touch. Such properties as size, shape, distance, and roughness of objects which may be observed in any one of these three ways show significant differences. It seems quite impossible, therefore, that the fineness and the accuracy of vision, for instance, could ever be derived in any manner through the aid of kinaesthetic properties. The latter, compared with those of vision, are indeed very gross. The *stimulus* in all these kinaesthetic properties apparently comes from the push and pull of the muscles and the tendons, and the play of the joints against each other. It is not extra-organic.

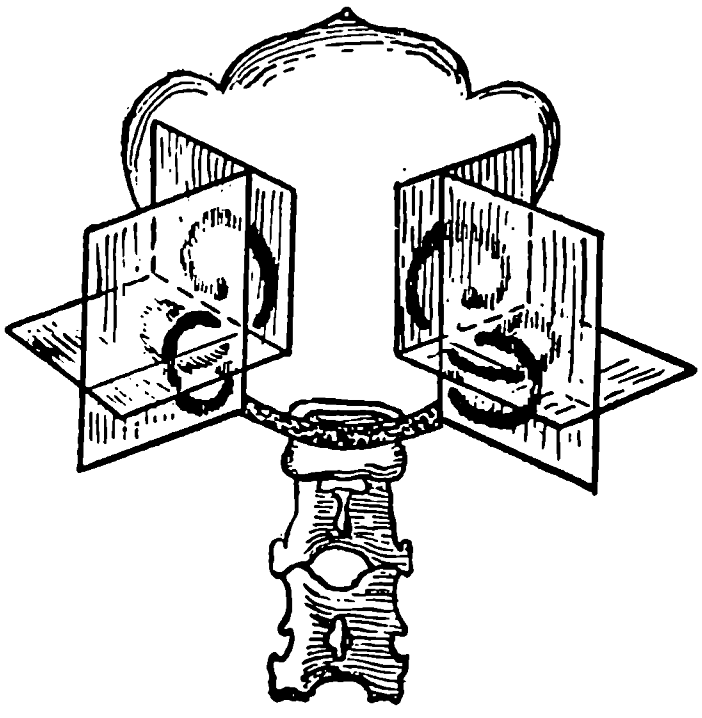

FIG. 51. A sketch showing the three planes of the vestibular mechanism.

B. *Vestibular*

a. Position and Movement. The position and the movements of his head and, within limits, of his trunk are also perceived by an individual through the functioning of the semi-circular canals. These canals which form a part of the inner ear are situated slightly above and behind the cochlea (Fig. 51). One lies in a horizontal plane, another is placed vertically in a right-left direction, and a third stands in a back-front plane. Partly filling each canal is a fluid — endolymph — quite like that found in the cochlea. At the base of each canal there is a slight enlargement which houses a small group of hair-cells. These are, presumably, the sensitive cells functionally concerned in producing the vestibu-

lar properties. When the head is turned in any direction, the endolymph within the canal is supposedly moved, thereby bringing about a change in the functional level of these structures. The individual observes that his head has moved in a certain direction or that it rests in a particular position in quite the same way that he observes that his hand has moved or is in a certain position. If the turning is done very slowly, with the eyes closed, no movement is observed. If the turning is done uniformly and not too rapidly, an individual may cease after a bit to observe any movement. Nor will he, if he is slowly stopped. But if suddenly stopped, he will immediately observe himself to be turning in the opposite direction — a very significant perception in the case of the airplane pilot.

Since the stimulus and the possible sense-organs in this case as in all other cases are wholly submeaningful, our knowledge of these particular causal factors is extremely limited.[1] In every case, however, an individual perceives that his head or his whole body is either fixed in a certain position, or is turning, rapidly or slowly, in a certain direction. Or, he may simply observe that objects move rapidly around him, and that he must struggle to maintain his balance. Here is the perceptual property of dizziness.

b. Dizziness. 1. *Rôle of Vision.* If an individual has been on board a ship, he may remember how quickly he perceived a slight difference in his space relations as the vessel lifted on long swells. If he has ever been seasick, he must certainly recall how he perceived slight movements of the ship. The pronounced dizziness and nausea which often appear in traveling by ship or train, or in swinging or swaying in a tree, may presumably be attributed in part to the functioning of receptor structures in the semi-circular canals. But there is possibly another contributory factor involved in all these cases. Occasionally, the closing of an individual's eyes will actually bring partial or complete relief from such properties. Credence is thus given to the assumption that the visual perception of the movement of closely surrounding objects as in swinging, or in the slow rise and fall of the horizon, as seen from the deck of a pitching ship, is the primary factor involved in the production of dizziness. Eye movements, on the one hand, and

[1] Franz and Gordon point out that we know at any given moment the position and movement of parts of the body, but we are not aware of the sensory components upon which this knowledge depends.

disturbances in the normal functioning of the stomach and other parts of the organism, on the other hand, may be closely related. At times, nothing except continued functioning under certain conditions can possibly rid the individual of such psychological properties. Yet men who have spent a lifetime at sea may show dizziness under unusual conditions, such as riding on a street-car or in an elevator.

Individuals who originally show dizziness or nausea while riding in an elevator may quickly lose these properties. The particular nature of any organic change which may be involved in such perceptual losses is not known. Certainly no change can directly take place in the vestibular operations which result from riding in an elevator. These are purely mechanical matters involving movements of liquids. The changes accordingly seem to be psychological; that is to say, there comes an apparent *disregard* of the rapid visual motion of surrounding objects. That it is largely visual is suggested by the fact that an individual by closing his eyes may lose most if not all of the dizziness present under these perceived conditions. In this same connection we refer the student to the dizziness and nausea which often accompany visual perception from very high places. These, too, seem to disappear very quickly either with a loss of the individual's fear, or with the visual strain, so common, at first, under these conditions. These are, therefore, not structural but functional phenomena. If they were of the former sort, they would scarcely be understandable.

2. *Effects of Disease.* While the evidence is somewhat ambiguous, it seems that where a diseased condition exists in the semicircular canals, as a result of which the sensitive structures become non-functional, the perception of head and bodily movements with eyes closed may completely disappear.[1] In such cases, dizziness may also be lost. At first thought this loss might really seem to be quite desirable. Yet it may, however, have serious disadvantages; for the individual may be wholly unable, without the use of his vision, to distinguish, for instance, between up and down. Should he then be deprived of the use of his eyes as in darkness, thereby losing all ability to orient himself in a spatial manner, he may possibly drown in deep water. He is unable to perceive the proper direction — up or down — in which to swim. Likewise,

[1] Where possible *kinaesthetic* properties are eliminated as while riding in an airplane or in a boat.

if such an individual were an airplane pilot, and quite dependent upon these vestibular properties for guidance, he would face great difficulty in driving successfully through fog or darkness. Dizzileless men do not make good airplane pilots. Regarded as a whole class, deaf individuals apparently show more bodily sway than the non-deaf do. It is probably true that a certain degree of normal control is lacking in such individuals. It is assumed in such cases that the pathological conditions which produce deafness as a result of cochlear disturbances may also affect adversely the functions of the vestibular mechanisms.

3. *Partial Paralysis of Eye.* The property of dizziness which characterizes some individuals may unquestionably be aroused solely through a change in the conditions of visual perception. From time to time, cases of partial paralysis of one eye occur with resulting effects of considerable interest to psychology. When an individual with such an eye tries to use it quickly, as in walking or running, along with his good one, he may instantly perceive that his environmental objects vary in their rate of movement. A part of the time they apparently move at a normal rate; but at other times they will suddenly move at a more rapid rate. The observed rate seems to depend upon the manner and degree to which the partially paralyzed eye is used. As long as the two eyes work normally, environmental objects are perceived as non-moving. But when they do not coöperate properly, the objects are perceived to be in rapid motion. The perception of the unusually rapid movement actually makes the individual quite dizzy. To avoid dizziness and possible illness, he shortly discovers, while walking and running where quick ocular movements are required, that he must close the inadequate eye. And when he does, his dizziness immediately disappears.[1]

Here is, indeed, a very striking example of a fairly significant change in a functional characteristic of a human being without any structural defect occurring to the slightest degree in the sense-organs themselves. The retinal organs of *vision* in such cases are in no way disturbed. Neither *visual sensations* of dizziness nor *sense-organs* of dizziness[2] are to be found here. There is, further-

[1] See Duane, "Visual Vertigo" (*Ophthalmology*), p. 308.

[2] The student can better appreciate now the significance of any approach by way of sensation. It is impossible to speak strictly of a sensation of dizziness. Dizziness is a clearly observable property of a human being under one total set of conditions.

more, no dizziness stimulus. Under one set of conditious, objects are perceived to have one nature. Under another set of conditions they are perceived to have another nature. As long as quick movement of the affected eye is not demanded, vision is apparently quite normal. This, we suggest, is an illuminating point: A partially paralyzed eye that *works*, yet fails to work coöperatively, brings an outstanding change in the psychological activities of an individual. The environmental objects which surround him suddenly move faster than they normally should, and the individual becomes dizzy. This point tends to make clearer the intimate dependence of normal functioning upon the nature of the total organism. A slight change in one mode of functioning may be followed by great change in other ways of functioning. The organism shows a diversity of functional characteristics, yet is highly integrated.

C. *Organic Properties*

a. Thirst. Although the muscles which move his limbs may be quiet, and his head may be at rest, an individual may still perceive significant properties of his organism. There are, among others, those of thirst, hunger, satiation, and drowsiness. Here are psychological characteristics which are different from all others we have so far discussed. Different properties of thirst appear under different conditions. One form apparently appears at times in connection with the drying of the tissues of the mouth. When the moisture content of these falls, the individual observes that he is thirsty. The mouth and throat may be dry, as in the case of the public speaker, without any accompanying thirst which must be satisfied by drinking. Where thirst exists together with a dry mouth, the resulting tension may be changed by the aid of some acid — lemon juice — or by means of ice. Thirst may thus be reduced. But a time may definitely come when all such measures are wholly inadequate. It is no longer a local matter.[1] The total water content of the blood and of the body has fallen below the

[1] It is better to regard the physical dryness of the mouth as being merely a *bodily symptom* of a general organic condition. Thirst, then, is not caused by the mouth condition itself. If the student will consult Howell's *Physiology*, he will find references to experimental studies on dogs from which the salivary glands were removed, thereby producing a permanent state of oral dryness. These animals, however, showed no abnormal increase in their intake of water. They required their usual amount of water.

normal *biological level established for the individual through heredity.* If additional water is not introduced to raise it to the inherently determined level, the individual will suffer indescribable agony throughout the *entire* organism. Thirst is not always localized, therefore, in the mouth. This may be taken to mean that there are actually no specialized sense-organs of thirst localized at any particular region of the body. No specialized sense-organs are needed — it is a *property* of the protoplasm of the whole organism.

Moreover, there is no *specific* stimulus for thirst, in the sense of a particular form of energy applied to some particular sense-organs. The stimulus may be thought of as being partly mechanical or partly chemical; but it must also be considered physiologically as being a *change in a biological condition necessary for normal life activity.* We cannot say, if we may use an analogy, that hydrogen stimulates oxygen *to form water.* We can say, however, that it is a necessary condition by virtue of the very nature of water itself. Nor can we properly say that water stimulates a plant to growth. We can say, again, that it is an indispensable condition. In some plants, there will be a little growth with a little water. In other plants there will be more growth with more water. Water must be regarded as being one necessary causal condition of life. Why this should be true, in all its respects, no one actually knows. We must understand, therefore, that the removal of (change in) a necessary condition for normal functioning will produce, in a living organism, very remarkable changes in its functional properties. One direct result, among many others, of the removal of water from a human being is the production of the psychological property of thirst. The student will accordingly recognize in this case, as is true in other activities of the total organism, that the stimulus cannot be strictly regarded as it so often is, *namely*, as being precisely describable in terms of so much physics or chemistry. We do not mean in any sense to imply that there is no cause for these psychological properties — their appearance, their changes, or their disappearance — but we do insist that the cause be properly considered in terms of its more understandable nature. The withdrawal from an organism of any one necessary condition of its life activity, e.g., water, must be regarded as producing thirst (in addition to many structural and physiological changes) in essentially the same way that the withdrawal of alcohol or a drug when it has become a necessary condition of life activities *may actually*

kill the organism in a short time or cause it to suffer great distress. Finally, there is no possibility of considering thirst in terms of simple sensations. It has never been reduced to a non-thirsty status. Moreover, it is a clearly observable property which possesses very great significance for the organism and determines at the time many of its activities.

b. Hunger. The property of hunger may be related, in part, to contractions of the stomach under certain conditions. Normally, within two or three hours following the emptying of the stomach, there is a change in the mode of contraction. Its contractions again become more frequent and more vigorous. At this time an

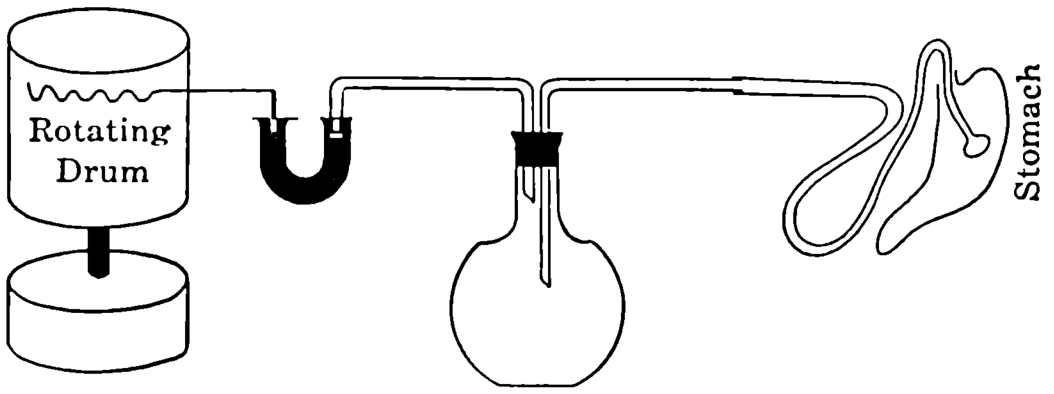

FIG. 52. A method of studying stomach contractions.

individual may observe that he is hungry. For purposes of securing a greater understanding of the possible relationship existing between these particular stomach functions and hunger, human beings have swallowed deflated balloons (Fig. 52) which were then inflated in their stomachs. In this manner, kymographic records of the periods of stomach contraction have been secured and related to the observational reports of the individual concerning his hunger. Within rather *narrow* limits, these data indicate a time relation between the stomach contractions of an individual and his perception of hunger pangs. That is to say, hunger and stomach contractions may appear simultaneously.

But certain indisputable facts tend somewhat to mar such a simple picture of the physiological basis of hunger — of the relation between physiological function and psychological function. We know, for instance, that the stomach contracts very vigorously during periods of food digestion; yet in such cases there is no *observable* hunger. It is theoretically possible, of course, that the contractions under conditions of a full stomach may differ in some significant way as far as hunger is concerned from those found under conditions of an empty stomach. We know, moreover, that very keen hunger may actually exist, as in case of diabetes,

even when the stomach is quite filled with food. Thus stomach contractions, which in some mechanical way might possibly affect end-organs to produce hunger, are not sufficient for an adequate understanding of this particular sort of functional product (hunger). No specialized end-organs for hunger have ever been isolated in the stomach or in other regions of the organism. There is a very large number of free nerve-endings. But careful microscopic examination reveals no other kind.

It is recognized that after a few days during which no food is ingested, the stomach contractions largely — not wholly — cease. Some students, speaking very loosely, say that the stomach has "adjusted" itself to the absence of food and so has ceased to contract as it formerly did. Yet this is an indisputable fact. The longer an animal goes without food, the more voraciously does it take food when found. It is only after long starvation that civilized men may find themselves eating human flesh. It would seem if stomach contractions were the primary cause of hunger that an organism, long deprived of food and showing no stomach contractions, would become totally indifferent to food and so refuse it when offered. But no sensible person can view a starving animal taking food and continue to talk about hunger disappearing in a few days as a result of a decrease in rate and extent of stomach contractions.

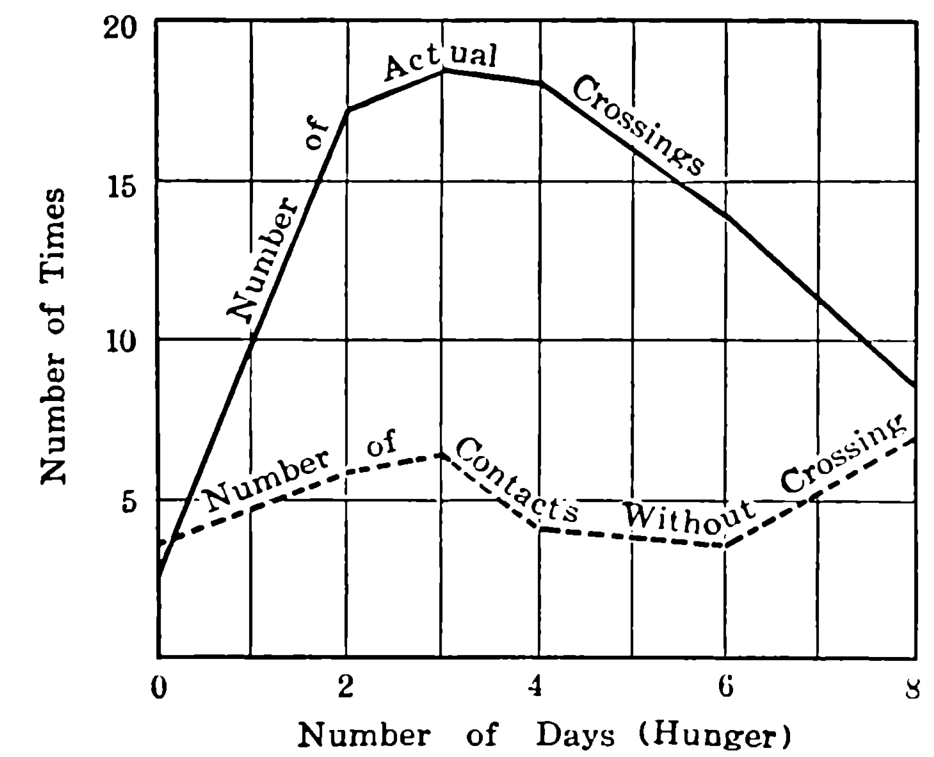

FIG. 53. Do these curves indicate that hunger disappears in a few days in an animal? (After Warner.)

Figure 53 shows the average number of times during an 8-day period that rats actually crossed an electric grill in order to secure food. It also shows the number of times that they stepped upon (contacted) the grill but did not cross. The former number drops while the latter number rises. Warner remarks in part that observation of the behavior of these animals on the 8th day leads one to say that the hunger drive is as strong as ever. But the decrease in the average number of crossings is a result of the de-

creased capacity to resist the electric shock. It is possible that food denial may affect both the animal's tendency to approach food and its capacity to withstand electric punishment.[1]

Hunger, psychologically speaking, is a perceptual property of an organism. A human being says, "I am hungry"; or, "I am not hungry." He doesn't see, hear, or taste hunger. He observes it in other ways. As a direct result of his hunger, man acts in certain ways toward environmental objects. Hunger, *biologically speaking*, must be regarded as being a general organic condition or a state of the total organism. It is, in particular, a functional condition of the nervous system — primarily, the brain — possibly induced in part through a change in the chemical constitution of the cells and the blood. Experimental data seem to indicate that, when the sugar content of the blood (which simply reflects a particular condition of the organism) definitely falls below a level necessary for the *normal biological activities of life to continue*, the property of hunger immediately appears. Some recent work in this connection is rather instructive. Two experimenters discovered, for instance, that the sugar content of the blood of a human subject, which they were studying, clearly varied from one test period to another. Although at first puzzled, they finally attributed the fluctuations to the unintentional introduction of a causative agent. The rise was due to the subject's having smoked a cigarette between experimental periods. Upon looking for the particular causal factor in smoking, they discovered that there was a period, ranging from 2 to 3 hours after eating, in which the sugar content of their subject's blood might rise, after smoking one cigarette, from .08 per cent to .14 per cent.

From the results of their tests upon this biological phenomenon, these students agreed that the nicotine derived from smoking, upon reaching the adrenal glands, released a small amount of adrenin which acted in turn upon the liver to free the sugar (glycogen) stored there. They found from their subject's observations, that a definite decline appeared in the degree of perceived hunger at the same time that the sugar level of the blood, affected indirectly by the smoking, was apparently rising.[2] These experimental

[1] Warner, L., "Study of Hunger Behavior in the White Rat by Means of the Obstruction Method." *Jour. Comp. Psychol.*, 8.

[2] "The acceleration of sugar metabolism thus demonstrated," they write, "affords a possible explanation for the fact that smoking diminishes hunger in users of tobacco. Hunger appears from our observation and those of others to arise

data may also point the way to a more adequate understanding of the universally recognized soothing effects of smoking (disregarding any habit implication). They may also make understandable the well-known fact that a full meal normally tends to reduce a man's irritability and to increase his sluggishness and good nature. Every intelligent wife recognizes, of course, the desirability of postponing the discussion of delicate and touching problems with her husband until after he has had a full dinner. After smoking and after eating, the sugar content of his blood definitely increases and so may his good humor. We offer the student this same general organic condition as a possible explanation of a very striking change in subhuman behavior. It is recognized, for instance, that if bees can be started to eating honey, they are much less irritable — much less likely to attack. When they are gorged with honey they can actually be handled with greater ease and with less danger. A little squeeze now does not produce a sting.

Various other properties are partly related to different regions or organs of the body. Those distressing perceptions of nausea, suffocation, and distention refer, respectively, to the upper alimentary canal, to the chest with the lungs, and to the abdomen. These several characteristics are both unique and unitary. They have not been reduced, in any way by any scientist, to another status or level. They are, in short, meaningful properties of very great significance to the human organism in terms of its general welfare and behavior. They are properties which an individual may observe from his earliest days.

within a definite time after the blood sugar falls to fasting level. Our observations on the meal-time intervals indicate that the hyperglycemia following a meal definitely relieves the fatigue and irritability that generally develop soon after the fasting level of the blood sugar is reached." (H. Haggard and L. Greenberg, "Effects of Smoking upon Blood Sugar." *Science, 79*, 1934.)

OUTLINE

CHAPTER IX. SOME RELATED PROBLEMS: TIME, LIMITS, "ILLUSIONS," AND ATTENTION

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   a. The Indifference Point
      1. Unfilled Periods
      2. Filled Periods
   b. Some Conditions Which Affect Temporal Perception
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      2. Sleep
      3. Hunger
      4. Unlocalized Organic Factor
      5. Place of Need
VI. Perceptual Limits
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      2. Not an Unreal or False Observation
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   The Mirage
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VIII. The Properties of a Thing
IX. Attention
X. A Final Word
   a. Significance of Meaning
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   d. The Place of Learning in Visual Perception (Cataracts and Strabismus)

CHAPTER IX

SOME RELATED PROBLEMS: TIME, LIMITS, "ILLUSIONS," AND ATTENTION

V. Time Perception

Time as measured on the face of the clock is obviously a phase of space relations. Space is simply translated into time. This involves understanding as well as learning. Much of the perception of time has to do with objects. The objects of an individual's environment change; they are different. We have assumed that he is able, within certain limits, to observe directly such differences in his visual, auditory, and tactual fields. He can perceive that some objects move rapidly. The rapid increase or decrease in the size of a balloon, the quick passing of a racing airplane, the dash of an insect across his hand — these are immediately experienced. He can as readily perceive that other objects move slowly.

a. The Indifference Point. Considerable work has been done upon the perception of very short time objects. We have said that in the case of *unfilled* intervals which are less than $\frac{7}{10}$ second in length, the second is more often perceived to be shorter. When the lengths are increased beyond $\frac{7}{10}$ second the second is usually over-estimated.[1] This length ($\frac{7}{10}$ second) is commonly known as the indifference point for short-time perceptions, because at this time there appears to be no constant error either way. In a recent study (27) upon time discrimination between pairs of continuous sound objects (*filled* intervals) which were less than $\frac{9}{10}$ second in length, the second member tended to be *under-estimated* with reference to the first. However, when the stimulus patterns were made longer, the second was more often perceived to be the longer; it was *over-estimated.* The indifference point in such cases was about $\frac{9}{10}$ second. Generally speaking, continued observation tends especially in the case of filled intervals to introduce new

[1] McGeoch has pointed out that intervals, either filled or empty, ranging from one-half minute to five minutes are over-estimated. Ten minute periods when filled with interesting or uninteresting material are under-estimated.

factors, such as the possible recognition of one or both of the stimulus-objects, with a resulting change in the functional product. The indifference point may shift to a different length.

b. Some Conditions Which Affect Temporal Perceptions. Temporal perceptions are closely related to other forms. At times, kinaesthetic properties, such as unusual fatigue, apparently play a part. Time, psychologically speaking, may drag interminably when an individual is very tired. Expectation, anxiety, and impatient waiting may also affect an individual's time perceptions. Seconds when measured by the clock may be stretched into minutes when experienced by a human being. This is also true when some monotonous movement or action must be carried on. Under such conditions, if he does not observe other objects — more interesting things — an individual perceives such temporal periods to be long. When measured physically or when experienced by another person such time periods may actually be short. An individual while asleep does not usually perceive time, although he observes many objects in other ways in his dreams. His temporal meanings are usually as much lacking here as are many socialized meanings in the case of the ordinary sleep-walker. If visual and auditory properties are lacking at the time of his awakening, an individual may perceive the length of time which he has spent in sleeping partly in terms of the degree of his fatigue or of his freshness. In addition to the kinaesthetic, various organic properties may also be involved in time perception.

c. Organic Factors. Hunger is rather outstanding in this way. An individual may perceive the passage of time partly in terms of his degree of hunger. The accuracy of such perceptions naturally varies with the physiological conditions of the individual. If hunger appears early in the forenoon, because he had a very light breakfast, the morning hours often take on added length for him. There are, moreover, interesting cases in which a loss of organic perceptions is marked, among other ways, by striking loss in time perception. Such pathological evidence points toward the possibility of the participation in time perception of some general, undetermined organic condition. Such a condition might serve as a partial explanation of the ability of many individuals to awaken at a set time, without awakening several times during the sleeping period prior to that time or without having awakened at that time upon many previous occasions. There are other cases, especially

among the blind, where extraordinarily accurate temporal perceptions may be found. Such individuals are living "clocks." They can usually state the time of the day or night with apparent ease and unusual accuracy. Yet, curiously enough, they are wholly lacking in their understanding of the particular way in which they arrive at these meanings.

Although they are quite different, such temporal achievements are perhaps comparable with the astonishing mathematical feats found occasionally among relatively immature normal or among intelligently deficient individuals. At this time, there is a sophomore in University of Illinois who apparently possesses a degree of mathematical understanding characteristic of the second-year graduate level. Recently at a meeting in Chicago, a four-year-old boy surpassed many adults present both in the speed and the accuracy of mathematical calculation.

In these as well as in similar cases it would appear that nature occasionally enters more on the credit side of an individual's life ledger than we ordinarily expect to find. At other times, however, she apparently enters more on the debit side. In this latter case, a person may, for instance, show a surprising lack in his time perceptions. Normally, we say, the ledger balance. Most individuals are neither markedly superior nor inferior in their time perceptions. Most can do surprisingly well when they push themselves sufficiently to induce a larger degree of efficiency. Usually, they are rather content with their several inadequacies. They do not desire greatly to improve. Improvement in temporal perception, for example, does not usually carry commensurate rewards. There is no premium laid upon such achievement.

VI. Perceptual Limits

Every change or modification in man's *physical* and *chemical* environment, as we have said, is certainly not perceptible. Neither the addition nor the subtraction of a certain amount of the stimulus energy involved in a total situation may result in a change in observation; the organism may continue to experience its environmental objects as having exactly the same properties. The addition of the heat of one extra leaf to a roaring bonfire, or of the splash of a pebble to the din of Niagara Falls has absolutely no effect upon the perceived properties of either of these phenomena. But there are other situations, however, in which an addition or a

subtraction of an environmental factor is directly followed by a perceptible change. We can inquire, therefore, concerning the degree or the extent to which an environmental source of energy — an object or a total situation — must be physically or chemically modified in order that it may be perceived as being different; that is to say, before new properties appear or before old properties change or disappear.

Measurement in psychology is not measurement of the mind (mental agent) or of sensations in the mind. It is essentially an attempt to secure an understanding, which is expressible in quantitative terms, of some one property — some functional characteristic — of a human being. The student recognizes that it is quite *impossible to measure a human being directly.* Measures can be secured only in terms of what is done by the human organism in some particular way to some object. The determination of an individual's weight by means of scales, and his size and height by the amount of space filled are simple illustrations of what an individual doe. Psychologically speaking, we measure, among other ways, in terms of the locality, the size, the shape, and the number of objects perceived; by the character and the number of problems solved; by the rapidity, the accuracy, and the extent of movement; and by the number and the character of relationships established among objects in a given time.

Every measure must be interpreted in terms of a particular situation. This involves an organism with a certain history, state of health, and intention; a definitely specified and controllable task; and an environment in which such factors as illumination, noise, and temperature are known. A significant or perceptible variation of any one of these may change the measure. A slight change in the task may bring a large change in the value of the product. Poor vision may be found with high intelligence. Slow speed may occur with great strength.

a. Threshold Determination. While an individual sits quietly in a lightless and sound-proof room, expectantly waiting to make scientific observations in connection with some problem of perceptual discrimination, he may possibly hear the blood pounding in his ears and the air moving to his lungs. Then he hears or sees an object (a property or properties) in his field. He reports this observational fact by means of some standardized method to the experimenter who is working outside the room. The experimenter

may then make a slight change in the *stimulus* conditions, after which the observing individual may be unable to hear or see the object. Again, he reports this fact, or he says nothing. In this simple manner, several hundred observations and reports upon this sort of problem (perceiving or not perceiving) may be made during one working period. From the combined results of a large number of such reports, a *measure* of an individual's *lower perceptual threshold* or *limen* for some one particular property — *not all properties* — of an object may possibly be obtained. Mathematically speaking, this measure is really the average amount or degree of the extra-organic energy that is required to raise or change the organism from a sub-functional (non-observational) to a functional (observational) level with respect to a particular psychological property. It is the minimal quantity of energy necessary in order to induce a change in perception — to lift the organism over the threshold [1] from one state to another.

The experimenter carefully controls and records the exact amount of energy delivered to the observer at each observation and he then secures his direct report or no report upon it. He then attempts to relate the observer's reports to the varying amounts of energy which he used in each particular case. The results in some cases are striking. We have previously remarked concerning the astonishingly small amounts of energy possibly required in order to bring about a change in the functional level of a human being. Two illustrations will serve to make this point clear. One third of a billionth erg [2] of energy may be sufficient under certain conditions to raise vision to a perceptible level, that is, to the first noticeable stage (lower threshold). In the case of audition, a trillionth part of an erg may lift the organism to a functional or observational level. These quantitative values are so infinitesimal as to tax the imagination of a human being in its attempt to grasp them.

b. Determination of a Difference Limen. The individual may again sit in the same room. The experimental problem, however, is different. Now an auditory or a tactual object can be perceived. The individual is asked to state whenever some *one* property of this

[1] The student can realize that if the threshold of a door were high, it would take more energy (effort) to get over it than would be required if the threshold were low. We can think of a lower threshold as the place where we pass from *no experience* over to an *experience* — in other words from *not* perceiving to perceiving.

[2] An erg is a measure of energy. One horse-power is equal to 7.46×10^9 ergs per second.

perceived object is observed as being different in the slightest degree. The experimenter presents the stimulus as a result of which the subject perceives some property of an object, and then a moment later, after he has added to or subtracted from it, he again gives a measured amount of energy. At each presentation, the observer is asked to report upon the property which is being studied. He may merely say: "It is the same," or, "it is different." Or, two objects may be given together and the subject may be asked to report which is the *larger*, or *longer*, or *heavier*

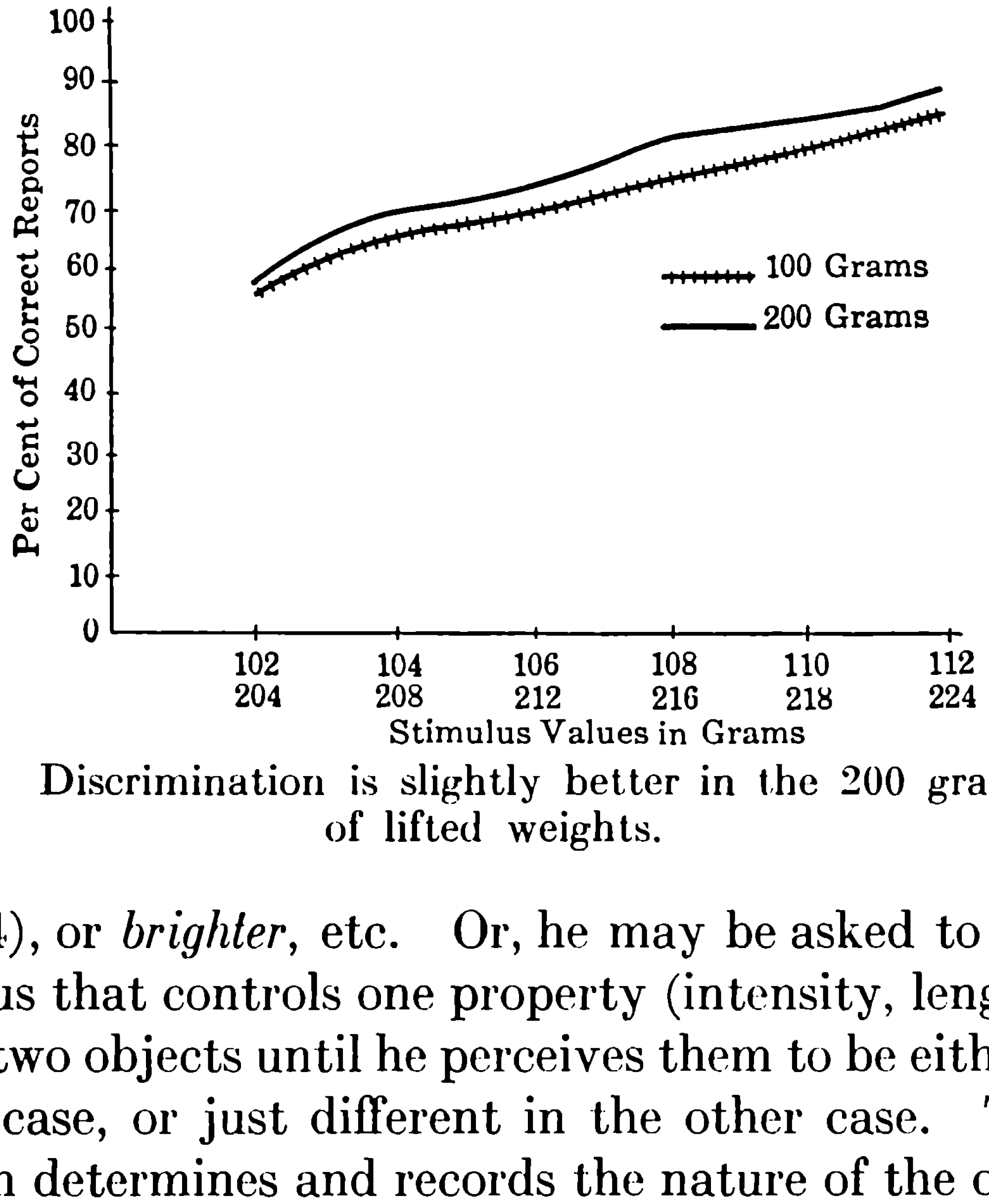


FIG. 54. Discrimination is slightly better in the 200 gram series of lifted weights.

(see Fig. 54), or *brighter*, etc. Or, he may be asked to manipulate an apparatus that controls one property (intensity, length, or size) *common* to two objects until he perceives them to be either identical in the one case, or just different in the other case. The experimenter then determines and records the nature of the observation.

From a large number of such reports, a final measure may be calculated in terms of the precise (average) amount that must be added to or subtracted from a given experimental situation in order to induce a change in the subject's perception of it. This value can be called his difference limen (D.L.) for this particular property. The derived measure really refers to the minimal quantity of some stimulus which produces a just noticeable difference (J.N.D.) between two successive perceptions of some one property of an object (situation). It is understood, of course, that the individual himself never observes these "just noticeable differences." He simply observes various properties of objects which either *change*

or remain fixed. These liminal values are derived through the use of certain *mathematical* methods which deal not with perceiving itself, but with known quantities of submeaningful stimuli. They represent, in short, measures of a physical and of a chemical order. They are in no way psychological values.

c. Other Measures. At other times, an individual may be asked (1) to move some member of his body as quickly as he is able upon perceiving a specified object, in order that an accurate measure of his speed of reaction may be secured; or, (2) to perceive as many objects (dots, letters, geometrical figures) as he possibly can, so as to secure a measure of his span of perception; or, (3) to point as accurately as he can at a perceived object, in order to secure a measure of his motor control; or, (4) to learn as rapidly as he can a number of perceived objects, in order to obtain a measure of his speed of learning. In these and in many other cases, a mathematically derived (not directly observable) measure is sought of what an individual is able to do under certain *specified* conditions.

d. Some Factors Which Affect These Values. The student will recognize, of course, that these quantitative measures which are expressed in terms of stimulus values intimately depend upon a large number of factors, some of which we have previously mentioned. A large change in any one factor usually results in a significant change in a threshold or liminal value. Among these possible factors we can list (1) the nature of the stimulus (whether it is electrical, chemical, or mechanical); (2) the nature of the sense-organ involved (whether it is visual, tactual, or auditory); (3) the degree of fatigue; (4) the character of earlier experiences; (5) the amount of previous training; (6) the heredity of the individual; (7) his occupation; (8) his age; (9) his general physiological state; and, finally, (10) the nature of his intentions (what he means to see, hear, feel, etc.). Such a list is, indeed, staggering. Yet every individual must surely understand that he has very definite functional limitations. Some human beings are limited by heredity and development; others by education and training; and still others by the chances of the environment. A study of the limits of psychological function is certainly not impossible. In certain cases the number of factors involved and the difficulty of measurements are really no greater than are to be found in connection with some of the non-psychological functions (e.g., speed)

which we have previously mentioned. In all such cases a study of function is necessarily confined to the nature of the product.

e. Weber's Law. Out of many psychological studies has come a fairly widely accepted generalization or law. For our purposes we can state it in this way: In order to produce a series of just perceptible differences (J.N.D.) in a changing object it is necessary to have definitely related increases in the energy output of the perceived object. That is, to the particular amount of the stimulus which is required under certain experimental conditions to produce a given property (e.g., a cutaneous property), a definite fraction of itself must in turn be added to itself to give that amount of energy necessary to produce another just perceptible difference, i.e., a difference in property. Thus, it may be necessary to add $\frac{1}{10}$ of the weight of an object to itself in order to produce an object which is just perceptibly different from the first object when each is lifted in the fingers. To secure a third step-like change (just noticeably different from the second) it would again be necessary to add $\frac{1}{10}$ of the (second) stimulus value to itself to produce the necessary third stimulus value. If he will study the accompanying diagram (Fig. 55), the student may secure a clearer notion concerning the general nature of the relationship existing between perceptible changes in a psychological property of an object on the one hand, and definitely increasing amounts of stimulus (physical and chemical energy) on the other hand. The vertical steps along the left-hand side represent just noticeably different steps in perceiving objects. The base line represents the physical weight of each object. This figure shows that the perceptual steps are equal but that the stimulus steps progressively increase (50 per cent at each step).

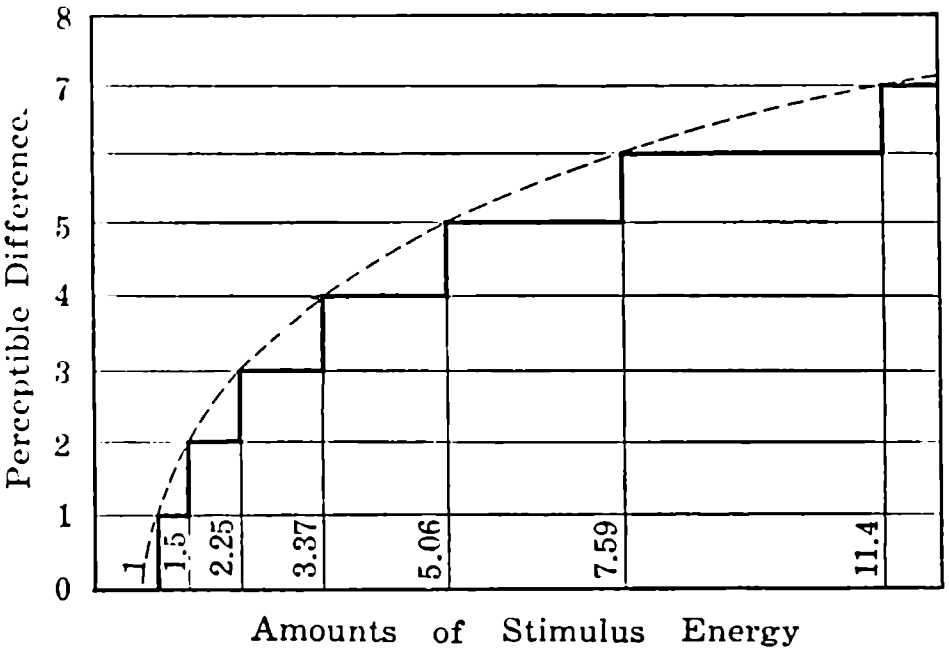


FIG. 55. A diagram showing relation between perceptual changes and energy (stimulus) changes.

f. Constant "Errors." We have referred to the amount of physical or chemical energy required to produce a change in the

functional level of the organism, that is, to decrease, or to increase, or to change the neural functions. Applied to this generalization (Weber's law), it means that the particular amount which must necessarily be added each time to that of the previous stimulus in order to induce a perceptual change is a fairly constant fraction such as $\frac{1}{25}$, $\frac{1}{40}$, or $\frac{1}{100}$ of the previous amount of energy. When fatigue, change in instruction, or other possible conditions appear, the proportional amount must necessarily be increased or decreased. In the discrimination of objects, for instance differences in weight (through kinaesthetic perception), a *constant error* is usually discovered where the physical differences are not very great.[1] A constant error is a mathematical term describing the fact that certain functional products of human beings tend to fall more in one direction (heavier or longer) than in another (lighter or shorter); one kind of property is observed more often than another. It may be regarded as being, in part, a measure of functional set. An individual, for instance, tends more often to perceive the second object of any two that may be used in making a study of his perceptual discrimination of weights as being heavier. When the *lighter* of two unlike objects is lifted last in 50 per cent of the cases, and the *heavier* object is lifted last in the other 50 per cent of the cases, the constant error is marked by a larger number of errors in the first case and a smaller number in the second case. This type of error gradually decreases as the degree of dissimilarity between two objects, in terms of one property, gradually increases. We assume, where the stimulus sources are almost equal, that when the functional level of the organism drops after being momentarily raised by lifting the first, the second weight has more work to do than did the first, and therefore the second is perceived to be (disproportionately) heavier. We can say that, within limits, a fairly constant relation seemingly holds between (1) a series of different stimuli in terms of the amount of energy necessary to produce (2) a series of perceptible differences in one particular property of objects. We assume, furthermore, that this relationship is to be attributed to differences in the way the organism works (functional levels).

Constant errors seemingly appear in all types of discrimination. They appear in the perception of differences between short sound

[1] It is understood that no one ever directly observes a constant error. It is derived from a series of observations by means of a mathematical method.

properties (less than $\frac{7}{10}$ second). Results of recent studies illustrate this point.[1] Individuals were asked to observe the comparative lengths of two *unfilled* time-intervals each bounded by clicks (C). The lengths of these time-intervals might be represented in this manner: (1) *C empty C*, (2) *C empty C*. Each was presented as the first member of a pair in one half the cases. Although the second object was, therefore, physically longer than the first in 50 per cent of the observations, yet in a significantly larger number of cases, the individuals perceived it to be shorter. It was, therefore, *under-estimated* with reference to the first object, although the subjects themselves knew nothing of this fact. In order, then, that two such auditory objects may be perceived as being *equal*, the length of the second must be somewhat increased. The same result may be obtained by decreasing the length of the first object, or member, of the pair. This general matter of error and adequacy of perception brings us to a topic of considerable significance to some students of psychology. It concerns the problems of the so-called illusions.

VII. The Nature of Illusions

The so-called illusions are experienced objects and situations. They are, strictly speaking, matters of perception. But there are, however, no strange or peculiar properties to be found in these cases. The various objects which are involved are perceived in terms of their ordinary properties of size, shape, length, distance, color, and the like. Moreover, an illusion cannot strictly be regarded as concerning the observation of an object which departs in some strange manner from the "true" character of the object (that is, gives "false" knowledge about it). We do not grant in any sense that "an illusion consists in responding to a sensory stimulus by perceiving something that is not *really* there — that the stimulus is misread. Instead of the true object a false object is perceived" (Woodworth). Things which are absolutely caused must be what they seem under definitely specified conditions. How can a thing ever be directly known except as a result of the functioning *of a human being?* Each observation of an object within a particular situation must be just that and nothing more.

[1] See studies by Woodrow.

It should be clearly understood that each object in an individual's environment may possibly possess many unlike psychological properties. Each property is, moreover, the direct product of a particular way of human functioning. Every experience of an object is really an observation of its property or properties. Thus, in Fig. 56, the student at different times may see the circles grouped into patterns of four, or see four in the center with a border around them. If we will recognize that any particular property of an object is the actual product or resultant of a total situation in which an object with a background is perceived by the organism, we prepare the way for a better understanding of the psychology in general and of the so-called illusions in particular. We accordingly assume that everything is determined; that nothing can exist without a cause. What we see, at any moment, is actually the only thing possible under a total set of determining conditions. If this is accepted, it follows that the perception of an object at any one time is never incomplete or illusory. Any "incompleteness" can appear only by comparing one case of perceiving with another case. We commonly understand that what is *real* (true) under one particular set of conditions in major life affairs may not at all be true at another time and under a different set of conditions. Everyone recognizes this truth. When sensibly applied to an understanding of perception, it follows that as a direct result of certain definable causal conditions an individual perceives an object as having certain properties. A change in any one of these causal conditions has its results. What was formerly perceived may no longer be perceived. What was "true" may no longer be true.

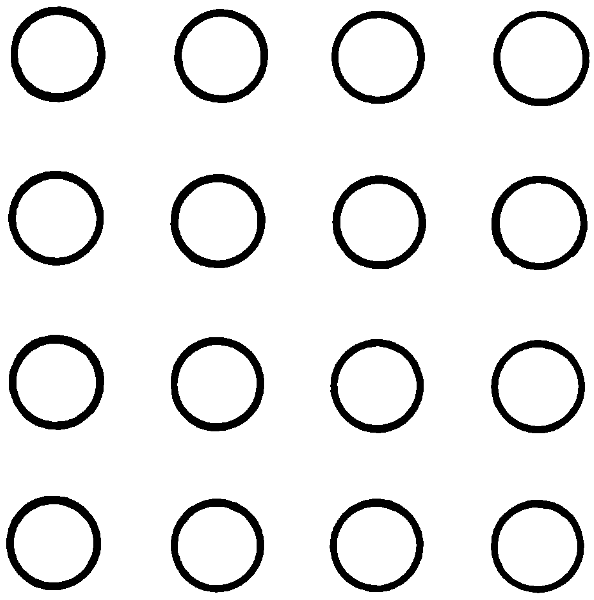
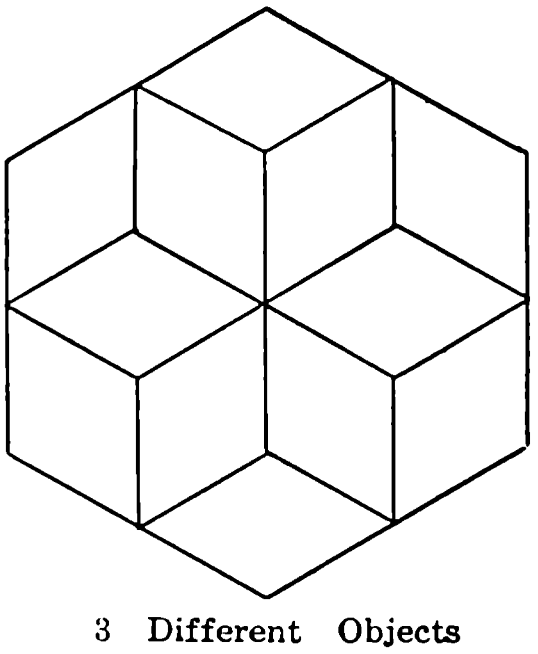


Fig. 56. Observe closely. Note different meaningful patterns.



3 Different Objects

Fig. 57. Can you account for such observations in terms of training or of stimulus?

A. *Some Conditions and Illustrations*

The nature of any observation is determined by the physical properties of the stimulus-objects (physics and chemistry), by the sense-organs (anatomy and physiology), and by the attitude, purpose, expectation, and history of the organism (psychology). When the light waves from some energy source are led *indirectly* into the eye (by a mirror, by a layer of air, or by water), it is of course the dislocation of the stimulus which contributes directly to the so-called illusion. Under certain conditions, when the light rays from an energy source are reflected indirectly into his eyes, the stage is prepared for the mirage. Whenever a fairly large change is made in the stimulus conditions, a change usually follows in the observed properties. Some of these changes in the psychological properties may constitute an "illusion." When the various sense-organs which are involved in experiencing an object differ decidedly in degree of sensitivity (eye and tongue), it is no longer the stimulus, but the sense-organs which are immediately responsible in part for an "illusion." Let us witness here the usual surprise of an individual upon *seeing* such a small hole in a tooth after it has been extracted. It seemed to be so large when he perceived with his tongue. Here, the spatial properties, although concerned with one object, are actually different. And, finally, when his need is quite strong, when his expectation is great, when training in disregarding certain objects is lacking, or when a long history has definitely tuned or set an individual, psychology must assist in explaining man's observations.

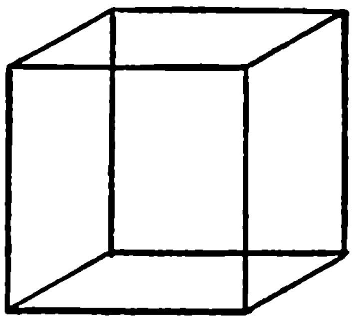


FIG. 58. In this case which spatial position is real?

The fearful person often suffers greatly because his central nervous system turns many physically harmless situations into psychologically fearful ones. In such cases, neither particular stimuli nor sense-organs can be regarded as the causes of such fear. The individual is looking for or expecting some object or event. He is definitely prepared to observe something and to act (run, shrink, jump) with respect to it. Children who have been "properly" reared are afraid of no object upon meeting it for the first time.

When an individual approaches two objects, which are quite alike except that the one is considerably larger than the other, with

the intention (task) of lifting them, he is definitely prepared (situational instruction) to expend more energy in lifting the larger than in lifting the smaller. As a result, the larger may be lifted more rapidly or easily, while the smaller seemingly offers much more resistance. The smaller object under such conditions is actually perceived to be the heavier. The fact that children do

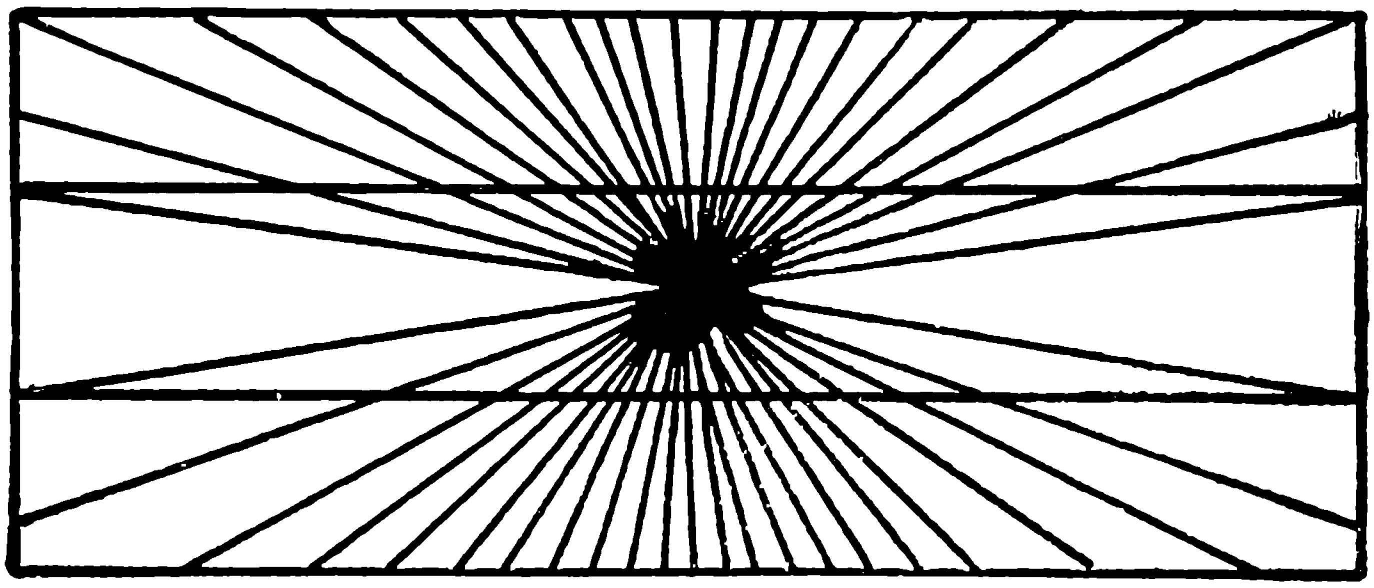


FIG. 59. Is the bulging physical or psychological?

not normally perceive in this manner is illuminating. They have been too strongly prepared through vision. The "illusion" usually does not appear. The larger object is heavier.

The student will observe when he holds this book before his eyes in an ordinary reading position that the two horizontal lines in Fig. 59 definitely bulge at the center. The lines are not straight. But if *he changes this particular relation of the object to himself* (*the observing organism*) *by tilting the book and by looking along the horizontal lines, so that he is able to ignore the other objects* on the page, or if he will squint his eyes greatly so as to aid himself in eliminating the radiating lines, the horizontal lines instantly assume a new property. They are now straight. If he is helped in his understanding by calling the product of the first set of conditions an illusion, he should do so. But he should realize at the same time that every other observation is an illusion.

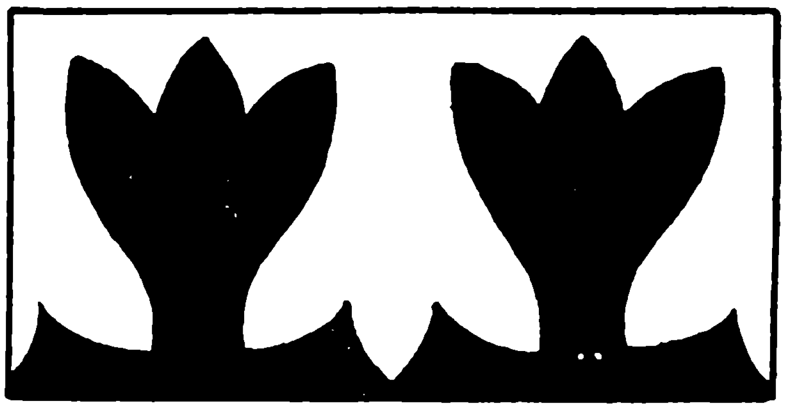


FIG. 60. Note the striking changes in spatial properties.

Illusions often refer merely to the successive perceptions of strikingly different objects when the physical energy and the stimu-

lus-pattern remain unchanged. Since two or more kinds of objects may be seen under these conditions, with only one being seen at any given moment, some writers regard such cases as being illusory. The student should consider some of the various objects possibly perceptible in Figs. 56, 57, 58, and 60. There is nothing strange about these different perceptions, unless it is strange that any one of these should be seen at all. At one time, the student may see one sort of object with certain properties of size, shape, distance, etc. At another time, he may observe another sort which will have different properties. Surprising changes in *spatial* properties actually occur in some of these cases, without the slightest degree of change in the physical conditions. When the *one* object is perceived, the *other* object is not seen; it no longer exists, or it has changed into another kind of object which may now be observed. These cases are significant, because they clearly show that perceptual products in part depend upon and change with intention to see a particular object. The student may be quite unable to see certain objects here until they are pointed out, or unless he searches for a while or until he turns the object (book) around so as to aid him. Once he has seen, however, he commonly knows what to look for; he is instructed. He intends to see. And so he may easily see what he could not see a few moments earlier.

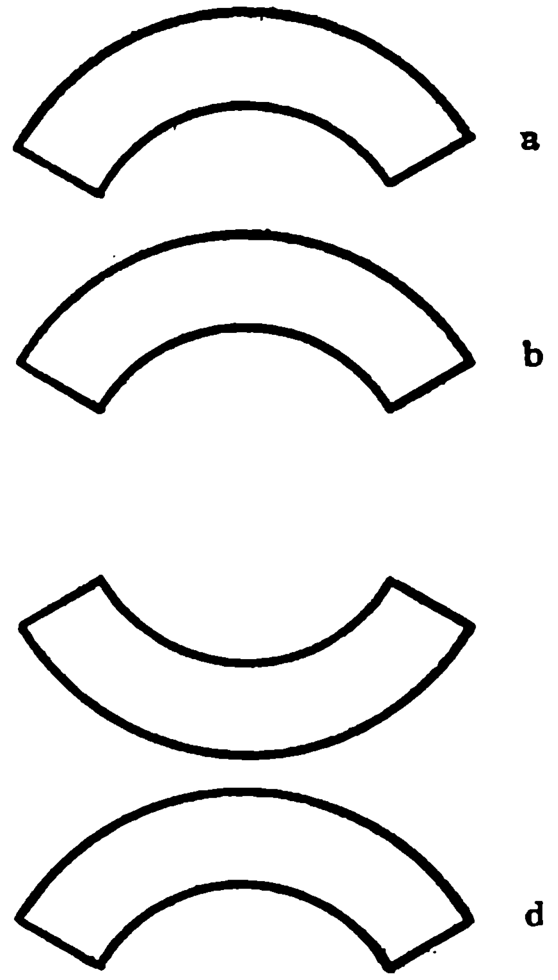


FIG. 61. In this simple manner, an "illusion" may be resolved.

At times the so-called illusion appears as a resultant of two objects so intimately related that the properties of one very clearly affect the properties of the other. This is shown in Figs. 61 and 62. The student can readily discover the effect upon the size of the sector a (Fig. 61) by changing its relation to b as shown by c. In the one case the two sectors are not perceptibly equal; in the other case, they are. The short cross lines of Fig. 62 form an integral part of the whole. As a result, the long lines which may be perceived as parallel under one condition are perceived as diverging or converging under another condition. A particular relational

property is the resultant of a total set of factors. When the long lines clearly dominate, the resulting object is different. The dependence of one property upon the whole figure is also shown in

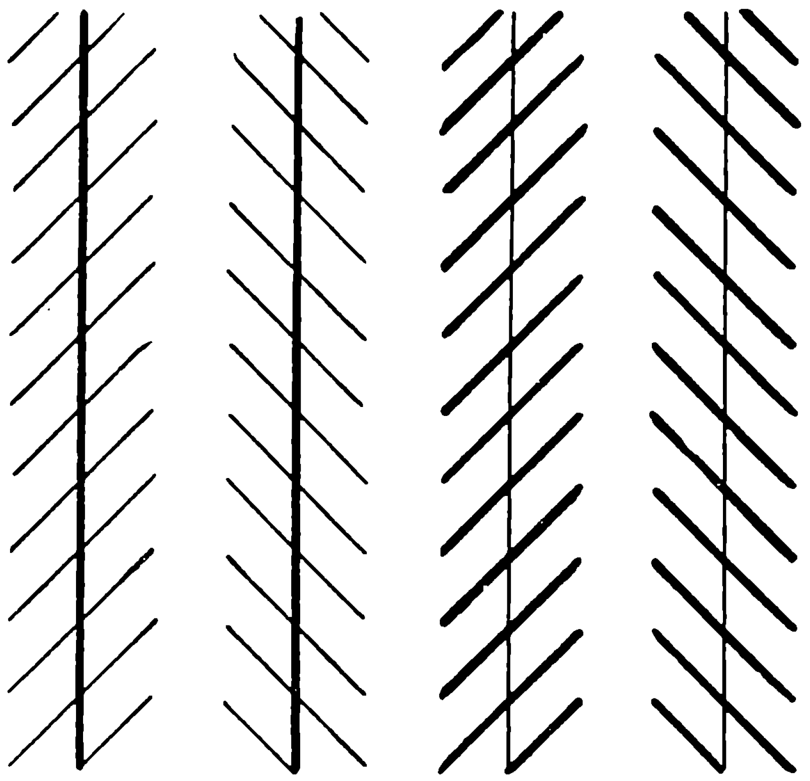


FIG. 62. Regarded in one way, the long lines are not parallel lines plus short diagonal lines. Regarded with eyes almost closed, the li es are parallel.

Fig. 63. The line xy seems to be broken. But when A (or B), for instance, is dropped, the line is straightened. The major value of such figures as these should be clear. They enable psychology to study the dependence of one characteristic upon others.

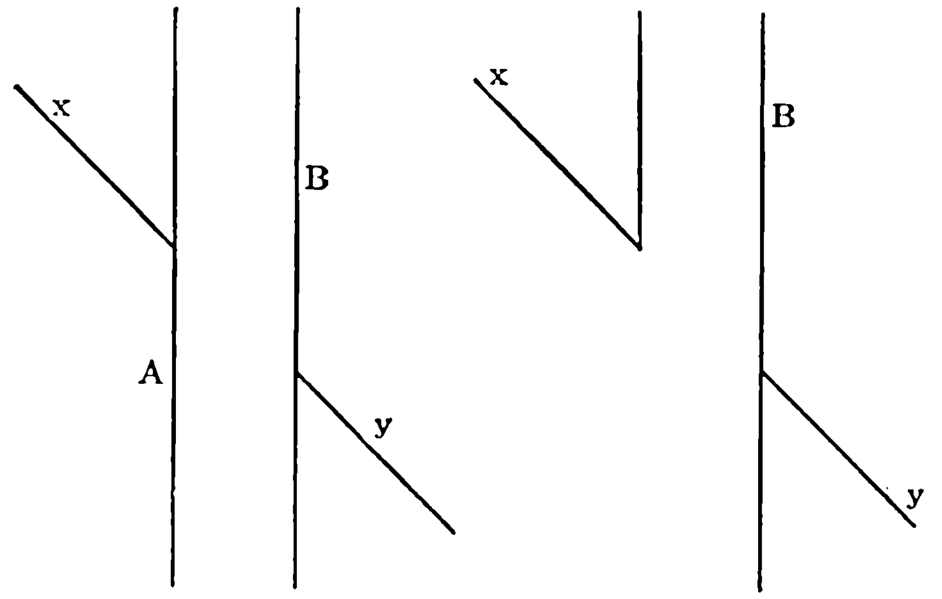


FIG. 63. Let the student determine how much of A or B must be dropped to straighten xy.

That one always perceives *objects* and not physical distance is shown in Figs. 64 and 65. Here the two lines A–B are perceived to be shorter than lines C–D. When those of Fig. 64 are shown *alternately* in the same place by means of the modern picture camera (or Fig. 31), the wings will flap rapidly back and forth and the horizontal line will stretch and contract like a rubber band.

If he looks at a stick which is partly immersed in water, an individual observes that it is bent. Moreover, he can never see the

immersed part as being different unless he changes his relations to it by getting down, for example, into the water with the stick. In this connection, we show Fig. 18. Here is a situation which every

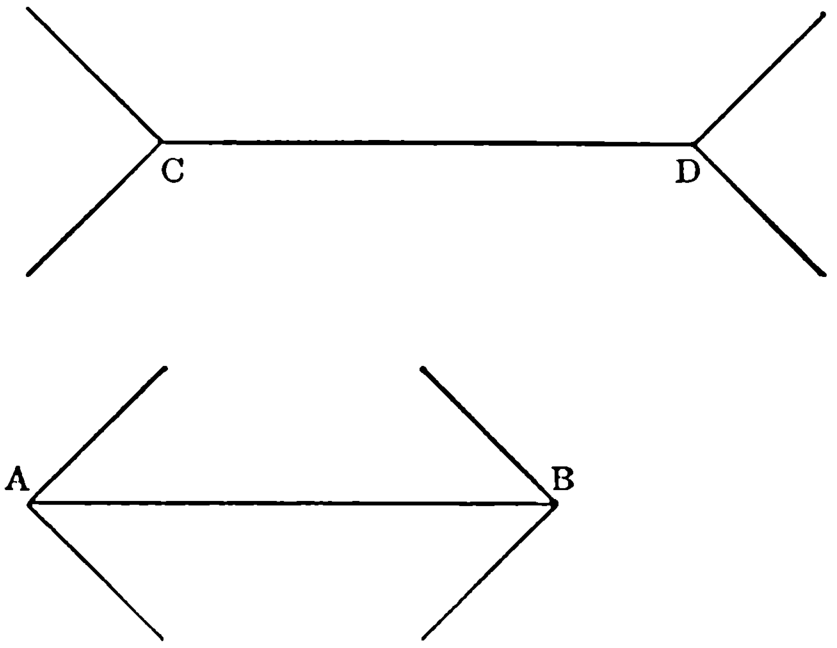


Fig. 64. Man perceives objects with particular properties — not physical distance.

individual, who has poled a boat in shallow water where he is able to see the bottom ahead and behind him, has repeatedly observed. The bottom of the stream is actually observed to slope sharply upward at each end of the boat. The naïve individual may readily be led to believe that if he moves ahead he will run aground. He may either stop, investigate with his pole, or get out. Upon looking back, he may also be surprised that he was able to get over the shallow place behind him. The perception is partly due, *physically speaking*, to the bending of the light rays as they leave the surface of the water. It is also due, *psychologically speaking*, to the individual's projecting the object directly ahead of him and *in a straight line* with his vision. He does not, of course, observe the physical bending of the light rays. Neither does he observe in any way the psychological projection. He really observes an object, *namely*,

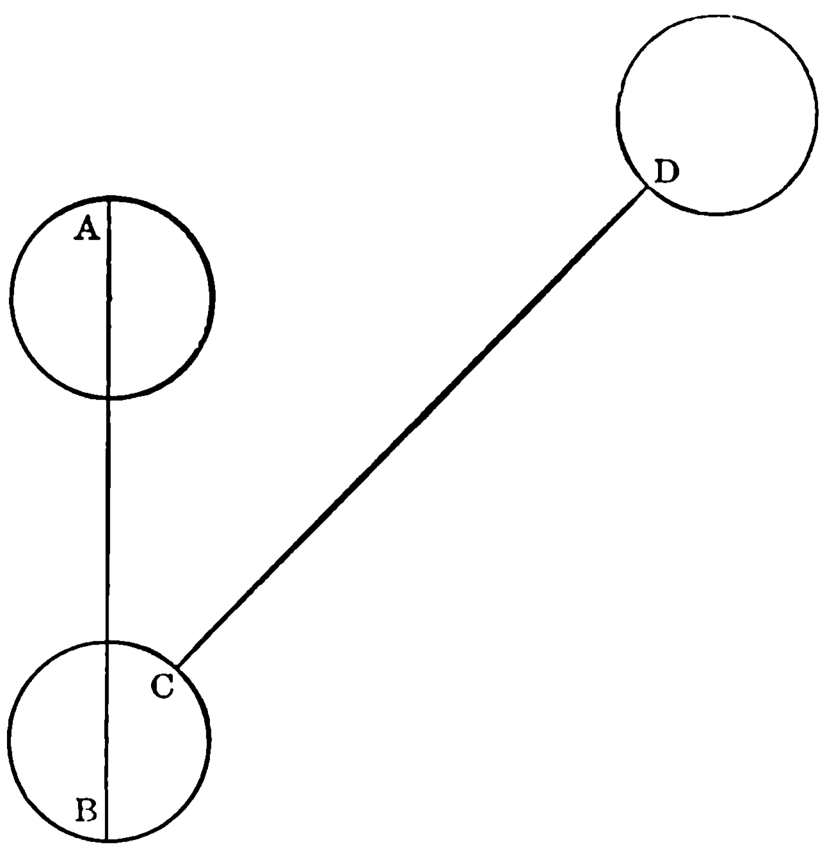


Fig. 65. Space is a relative matter.

the bottom, as having certain distance properties. He may also discover that the depth of the water constantly changes as the boat moves forward. What was shallower actually becomes deeper, and what was deeper becomes shallower. Here, again, is a striking case of relativity. What is true here is likewise true in other cases: What is perceived depends, among other things, upon the particular nature of the observer. In all such cases, there is nothing strange or peculiar. Things are often called illusions, but this terminology should not be permitted to mislead the student.

In these cases, let us ask, which particular property is right, or true, or correct? To the individual who has looked along the lines (Fig. 59), the first observed property (the bulging) may be regarded as an illusion. By means of his tongue an individual may feel a hole in a tooth. It may be perceived to be quite large. But upon looking at it in the mirror he finds in terms of vision that it is quite small. The first experience (touch) thereby becomes an illusion. If he had been lacking in vision, he might never have known the hole to be visually tiny. If an individual did not move forward in the boat, he might never know that the depth of the water varies psychologically from time to time. Moreover, an individual may see a lake in the desert, but when he tries to reach it by walking or crawling a weary distance he may finally realize that he has been led from the trail by a mirage. And it may possibly bring death.

B. *The Mirage*

A Simple Explanation. The desert mirage puzzles many students. They are commonly told that it is a *reflection* of some object. But the critical individual may see "water" on a desert, which is the most common phenomenon, when he knows that there is no body of water in a great many miles. It could not possibly be a *reflection of water*. Some bewilderment is rather to be expected in such cases. Moreover, it is seldom recognized that the causal factors in a desert mirage are quite like those which account for an object which is daily observable on concrete pavements. They are, however, essentially alike. Here is one explanation of the physical and the psychological conditions underlying the usual mirage (see Fig. 66). The air near the ground becomes hotter than the air a short distance above the ground. Light rays from the sky, or

for that matter any object above this hot stratum, upon striking this layer are bent either horizontally or upwardly, because light travels much more rapidly in hot air than in cold. They shoot out, therefore, to the observer. They may never touch the ground. But the latter perceives, as a result of the nature of his organism, an object as he would if a physical source were before him on the ground at P. The individual sees neither the light waves nor their bending.

The student should note that, *physically speaking*, he does not see water since there is no water there when such is considered in terms of its non-visual and its physical properties. He simply perceives an object as the result in part of the *reflected* sky. It so happens that certain visual properties under these particular conditions

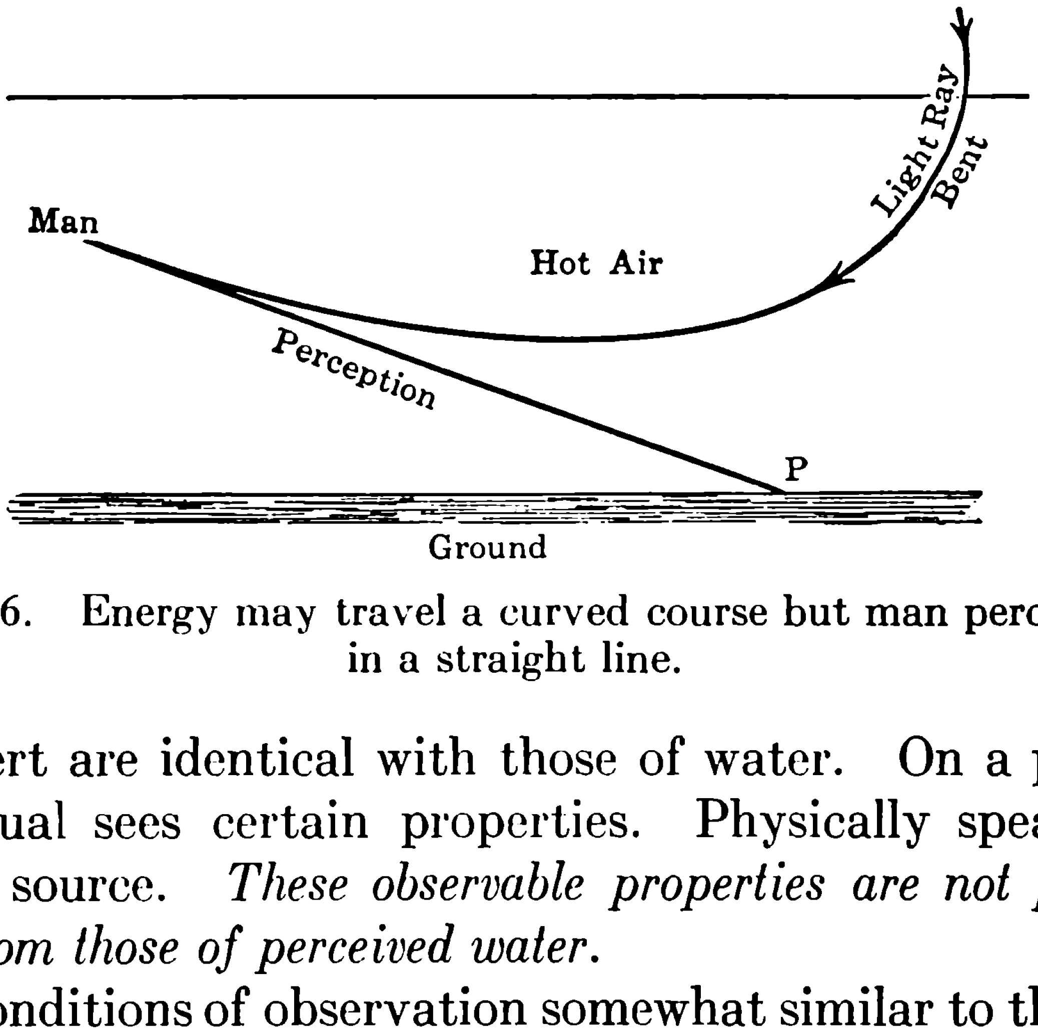


FIG. 66. Energy may travel a curved course but man perceives in a straight line.

of the desert are identical with those of water. On a pavement, an individual sees certain properties. Physically speaking, the sky is the source. *These observable properties are not perceptibly different from those of perceived water.*

Under conditions of observation somewhat similar to those of the mirage, objects may be seen for distances as great as sixty miles. This is especially true over water where the air is normally free from dust, where there is no barrier such as forests or mountain ranges, and where a cool layer of air may lie at the surface with a warm layer *above* it. Under these conditions, such objects as shore line, trees, houses, and boats are physically lifted to a sufficient height to be seen for many miles. The lifting is done at the level of physics — not psychology. One does not observe any such lifting. One can neither increase nor decrease it. Here the perceived objects actually appear in their normal spatial positions

and relations. Under the conditions of the desert and the pavements, however, the many objects usually assume an *inverted* position. The whole matter of such perceptions reduces, psychologically speaking, to the *projection* of an object to a place where, physically speaking, there is no source of energy. Neither physics nor psychology is able alone to furnish an adequate explanation of them. Psychology is absolutely as important as physics. If it were not for the straight-line projection, for instance, there would be no mirage.

These illustrations, as well as a great many others which we could cite if we had the space to discuss them, all point in the same direction. If a single property of any object, either human or non-human, is regarded in and of itself, it cannot possibly be said to be wrong or illusory, or inadequate. But if the property of an object which is produced through one kind of perception or sense is accepted as being *more truthful, more reliable, or more real* than that arising through another, an illusion may appear. Thus, vision inevitably makes touch illusory, and touch in turn makes vision illusory. A measuring tool might in some manner cause both kinds of perceptions to be illusory. Any one sense, we say, may make "fools" of us.[1] Above all, an individual never discovers an illusion when he directly approaches any given observation. It is only when he slips upon one property indirectly through another property (changed conditions) that he actually discovers his "perceptual inadequacy." No single perception ever bears the stamp of illusion upon its face. Illusions are not observable.

VIII. The Properties of a Thing

Now, let us take guidance here — let us get our bearings. Here is a fundamental truth. A thing may have many properties; and these properties may possibly be very unlike. Some are psychological, and some are not. Each is undoubtedly right in its own way; and the particular way is also right. A total thing — living or non-living — must necessarily be *defined and understood* in terms of what it does or how it is related to other things. The

[1] We may visually perceive the concrete road ahead of us to be covered with water. But if we look again in a few minutes, we may find that the water is gone. Here a *later* visual experience shows a *former* experience to have been illusory. In this sense, perhaps, we may say that "hindsight" shows many of our "foresight" experiences to have been "illusory." One does not, however, advance his understanding of life by taking this position.

many different properties of a human being, for instance, can be known only in terms of the nature of the manifold relations which it sustains toward itself and the various situational objects of its environment. A fuller understanding and a larger appreciation of this fundamental truth will unquestionably cause the critical individual to speak hesitatingly about the true man or the real man. He won't be so glib and so sure; for such talk obviously arises from the very naïve assumption that man — unlike an illusion, for example, — always shows the same properties regardless of the character of his relationships with other things. We venture to suggest that it is only the abnormal (insane) person who, for instance, may possibly be afraid (or unafraid) of *anything* regardless of its other properties, for whom this approximately holds true. Only the "insane" can possibly be the same — show the same functional properties — under all environmental conditions.

Perhaps a final illustration, which we take from Scott's story of his last expedition, may make this point somewhat clearer. In this country no one thinks of horses as being flesh-eaters. Yet Scott reports that their ponies, under the terrific cold of the Antarctic, became carnivorous and avidly ate chunks of raw flesh cut from freshly killed seals. The enormous change in *environmental* relations of the horses was accompanied by a striking change in *animal behavior.* We suggest that this change could be known and properly understood only under such conditions as prevail in the Arctic regions. Under the temperature conditions of Illinois a horse which ate flesh would unquestionably be regarded as being abnormal. To be known and understood, the activities of a creature — either animal or human — must be necessarily regarded in terms of a total situation. Such a situation always involves an organism, with a particular history, which is placed in a particular environment.

IX. Attention

Attention is not some special process added to perception.[1] It is not a particular function. It is neither a *mental* nor a *physical*

[1] Franz and Gordon point out that "The center of clear attention is a single object, a unity. But this unity may be in reality quite a complex organization of simple components" (p. 404). Gault and Howard remark that "attention is not a *special* process. It is the whole mental process itself in one of its aspects" (p. 105). Carr asserts that "perception always involves a bit of attention. Objects when attended to become clearer and more distinct" (p. 115). Warren and Carmichael write that "in the analysis of mental life and behavior no one process can be isolated and named attention" (p. 67).

force (activity). Moreover, it is not something which is concentrated at one moment and diffused or scattered at the next. Furthermore, it is not some agency that takes various fragments of experience and unifies — combines — them. It is no agency and there are no fragments. *To perceive, for instance, is to attend.* We shall not try, therefore, to separate perception and attention. Although one may "attend" to some object (situation) in other ways than perception, *namely*, memory or imagination, yet separation of attention as a distinct function is still impossible. We assume, then, that what we have said concerning perception holds strictly for attention. One "attends" to certain things and not to others for exactly the same reasons that he perceives some things and not others. When an individual is not observant, he is not attentive. One always observes something, so one is always attentive. Moreover, the individual is always prepared for functioning, which is to say he is prepared to "attend." Intention, wish, belief, desire, knowledge, expectation, purpose, and needs serve to determine attention — what is observed. Other conditions are considered in the next few pages. The *forms*, *range*, *degree*, *duration*, *fluctuations*, and *conflicts* of attention are in part really matters of perceptual observation.[1]

If the student will observe Figs. 58, 60, and 67, he will find that he observes different objects at different times. This seeing of now one object and now another when the physical conditions remain unchanged has been called fluctuation of attention. Actually, the objects themselves change — fluctuate; but nothing is ever observed to fluctuate in the observing individual himself. The student may possibly say that he is absolutely going to "attend" to one thing *only* in these figures but not to anything else — no other pattern. But he may shortly discover, even though he "attends" very hard, that he suddenly sees something else. Such changes normally occur in certain *familiar* objects every few seconds. Perception accordingly lends itself just so far to control through such factors as instruction or intention.

[1] As evidence of this fact we cite the following instruction which was given to each observer in a study of attention. The experimenters sought to measure the range of attention.

"You will be shown cards which contain a varying number of colored forms on a white background. Immediately after the exposure describe the forms you have seen, that is, give the *number, names,* and *qualities of the stimulus-objects* (11)" (italics ours).

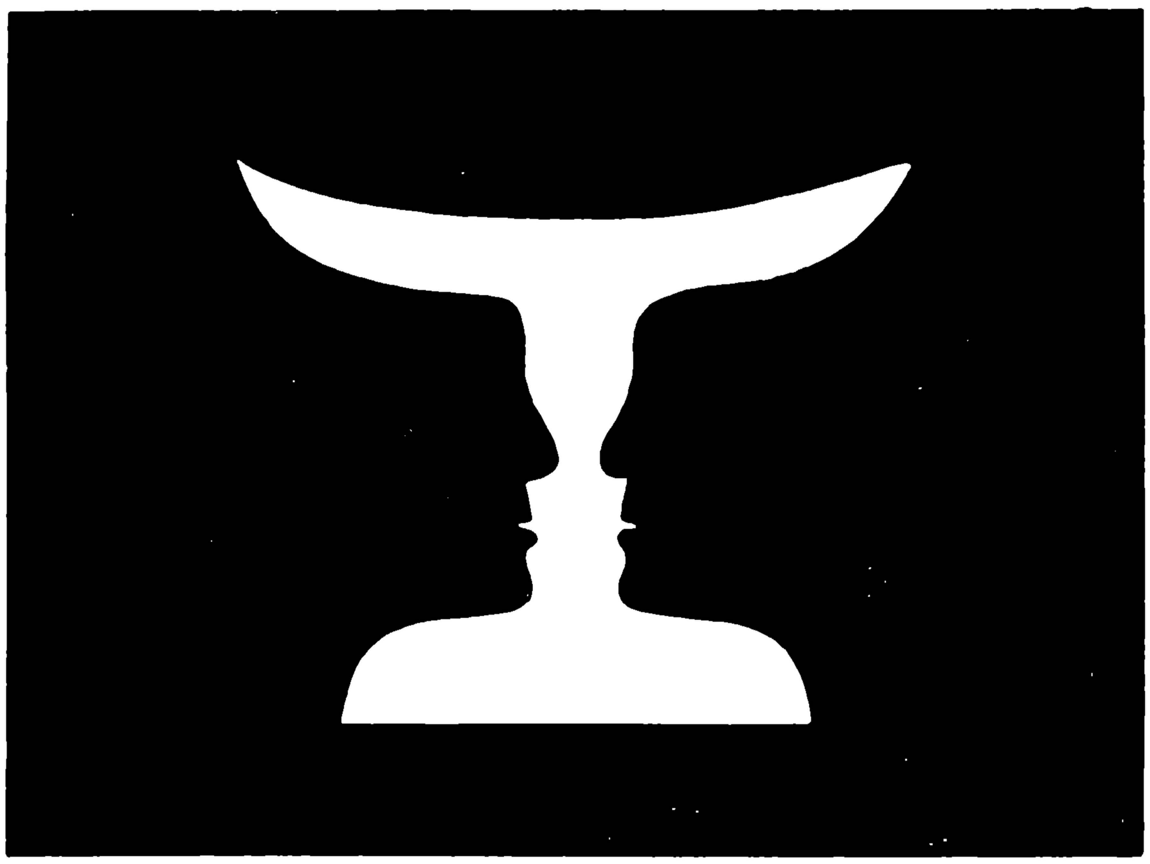
Involuntary and voluntary forms of attention, for instance, really describe observation under two different types of preparation. They do not refer to differences in the *objects* which are observed. The same properties may be perceived in both cases. Very often certain objects are perceived when the functional preparation is wholly unknown to the individual. (1) It may possibly be racial — the result of some need. Animals may perceive things that man ordinarily does not; feeble-minded individuals and little children may likewise perceive many things that normal adults usually do not. A short walk along the street with animal, moron, or child will furnish much evidence upon this point. Or (2) the functional preparation may be wholly personal. In this case, an individual may have forgotten or has no understanding of why he perceives. He simply perceives. Some things are perceived, however, where the tuning, setting, preparation, or instruction is definitely understood. An individual may possibly say, "I must get this work in order to pass this course"; or, he may say, "I have liked to study this material, for I have long been interested in anything that concerns human life." Let us say, then, that at times individuals perceive without knowing *why* and without observed instruction. This is involuntary attention. At other times, however, they understand why they perceive. Some deliberate intention, incentive, goal, or purpose is definitely involved. This is voluntary attention; it is perception under a definite instruction.

X. A Final Word

Perception is normally with us during every waking moment of our lives. Never can we possibly escape for any length of time, except by way of insanity, from the world of perceived objects. We always perceive a property or properties of an object in a total situation, even though at times the observed object may be ourselves. There is always an object or group of objects and a total situational background. The object may be either moving or stationary upon its ground. Or, as in the case of ambiguous figures (see Fig. 67), there may be one kind of object at one moment, but a wholly different kind of object at another moment. What we perceive depends upon extra-organic and upon intra-organic conditions. The intra-organic conditions serve in part to give meaning to the former to constitute a total situational meaning. A lecture audience, a busy corner in the city, a quiet isolated

monastery — each lends significance to what it embraces. That which does not belong by virtue of the very situation — that which is, in short, *incongruous* — may become either amusing or distressing. It may be quite amusing to students to see a dog suddenly appear on the lecture platform; it might be very distressing to hear a raucous orchestra and a torch-singer in a monastery.

Objects which quickly *change* in *color, size, shape, odor, distance, sound;*[1] objects which are *familiar;* objects which are *similar;* objects which have dèfinable *outlines;* objects which *satisfy* needs;



The Fountain of Youth

FIG. 67. Note the striking shift in observable objects.

objects which bear *significance* to some goal or purpose; objects which are *relevant* to the train of thought (look for human faces in Fig. 67) — all these, among others, determine our activities at any given moment. We can think figuratively of the flow of observation as a stream of water full of many different kinds of objects. Now one object is brought to the surface and now another. The object which a moment before was at the surface has now disappeared, to be replaced by some other object. Psychologically speaking, objects unquestionably arise out of and sink back into

[1] The behavior of babies indicates quite clearly that they will usually observe some *unusual* sound property but fail to show any response to very noisy objects which are permanent features of their environment. Babies select just as adults do. But we must not assume that either *learns not to hear.* Because either may hear *very clearly* if there is any cause. Thus there is no loss of ability to perceive. For example, in a moment of excitement, the farm boy may suddenly fail to hear the noises of a great city. But he has not learned to do so. He may hear them the very next moment.

an undifferentiated ground. Strictly speaking, we cannot say that they are present before they are observed. Nor can we say that they are still present when they are no longer observed. Their actual describable existence is absolutely dependent upon a total set of causal conditions.

To prevent (reduce) their becoming observable, many objects such as ships, cannons, and tractors were camouflaged during the World War by extending to them the *psychological properties* of surrounding objects. Ships, for example, were painted with long, wavy, bluish-gray stripes which produced a striking resemblance to the wavy contours of the ocean. It is commonly recognized that the inherent protective coloration of many animals actually prevents their emerging as a figure — an object. It is extremely difficult, for instance, to see young pheasants or quail when crouching. Woodworth remarks, in part, that what shall be "striking and impressive cannot be defined in purely physical terms."

These properties, for example, determine which particular objects will emerge and be observed. That which causes a particular situation to be figured, at the same time causes certain objects to be perceived. A mother, for instance, may be very busy with her many household duties. Yet she instantly hears the cry of her sick baby. To do so, she certainly does not need to be thinking continually about it. But her baby has tremendous *significance* for her; it is an integral part of her own history. She is functionally disposed toward it. She is instructed in many ways to hear it. This is especially true when it is ill. Its weak cry undoubtedly has great potency. Here, again, we see that psychology (not merely physics and chemistry) is important for an adequate understanding of human behavior.

The limits of perception, we assume, are ordinarily determined for us. Moreover, the organism is hereditarily disposed to perceive. Development may possibly occur, as we have said, over a period of years following birth. Such development concerns changes in instruction, intention, preparation, purpose, or needs. Knowledge develops and with it (as a measure of it) goes perception. It is unnecessary to assume that extensive learning is required in order to perceive every property we have mentioned here.[1]

[1] Woodworth remarks that while much needs to be done in the genetic study of perception, we may take it as probable that there are a few fundamental characteristics of perception which are not drilled into us by learning (p. 390).

Our personal history plays a very great rôle in a given situation. It actually determines within limits which objects we will perceive; it causes us to look for certain objects — to expect certain things; it leads us definitely to want to observe (see, hear, taste) certain things. If the student will thoughtfully consider the striking differences in terms of the objects actually perceived by an entomologist on the one hand and a sanitary engineer on the other as they walk together across some bit of country, or if he will consider the differences between a detective and an amateur who together look over the scene of some crime, or between a laboratory instructor and a beginner who must actually follow printed instructions in order to observe many characteristics of an object (specimen), he will undoubtedly realize what personal history does. It does not make the eyes keener or the brain more active. It does not make one individual able to see objects that another cannot, if the latter is normal and properly instructed. The training to which we subject all developing individuals aims actually to *instruct* them, *prepare* them, *set* them to *observe* certain properties (objects). Long ago it was pointed out that there are individuals who have eyes and see not, and who have ears and hear not. Functional development, so far as training is concerned, does this: It causes us to observe some things and at the same time not to observe other things. Within limits, one actually observes what he wishes to observe. This is the essence of perceptual development as far as learning goes.

But it is sometimes claimed that persons who are born blind and who are operatively given sight when they reach maturity are able to see only sensations for a few days, after which they learn to perceive! What is the truth here? It unquestionably appears that reliable evidence obtained from medical authorities — not anecdotes reported in philosophical[1] journals of the 18th and 19th centuries — stands wholly opposed to any such possibility. If a person were totally blind from birth, his ability to see at the age of twenty, for example, would equal his ability to move his arm at that age if it had been bound to his side since birth. In either case, the ability would supposedly be zero.

In this connection, Duane[2] (Knapp Memorial Hospital, New York) states, "In congenital cataract, operations can be made in a

[1] Proceedings of the Royal Philosophical Society.

[2] See his *Ophthalmology*, p. 643.

few weeks after birth. If the cataract is not operated upon, the development of the retina is actually arrested. The good results of a cataract operation that is performed at a later date are comparatively small so far as vision is concerned." In cases of full cataract, moreover, there is really not a complete lack of retinal stimulation. If there were, blindness would be common to cataract. An individual with full cataract in both eyes may report that he sees a light when the flame of a candle is held at a distance of 18 feet, which is a standard test used by physicians. Moreover, he ordinarily possesses color vision, unless the retina itself is non-functional. Duane also adds that "when — as in an adult — the development of the retina has once been completed, a cataract may last for many years without damaging the retina. These cataracts which have formed *in adults* have been operated upon with perfect success after lasting 20 years." Within the last few months two interesting cases have been reported in this connection. One concerned a woman who developed cataract during her adolescent (pre-marital) period. The first objects she saw, following her operation, were her husband and children. Her first comments were that they were more beautiful than she had expected them to be. The other case was that of a woman past seventy years of age who had had cataracts for more than 20 years. Her first wish upon the removal of the bandages was to see her flower garden. Let us also note here a statement by Myers (in his *Experimental Psychology*) that "in cases of congenital blindness the individual is at once able after operation to perceive differences in size and form. So instantly is a round object seen to differ from a triangular that the judgment is clearly independent of training."

Fuchs,[1] an international authority upon diseases of the eyes, points out that some obstacle which prevents the formation of sharp images on the retina may be present from earliest childhood. Such obstacles may take the form of (1) *opacities in the lens*, (2) *high astigmatism*, and (3) *strabismus*. "In all these cases[2] the retina, *owing to a lack of exercise*, fails to attain that delicacy of function which belongs to normal eyes, or the functional capacity which has been already acquired is lost; but absolute blindness never

[1] Fuchs, 12th ed. *Ophthalmology*, p. 237.

[2] Please note that Fuchs refers here to cases in which a *sharp image is not formed* on the retina. He does not refer to any case where there is no *retinal stimulation from birth onward.*

occurs. If the condition causing the trouble is removed in childhood, the weakness may then be relieved by persistently exercising the vision in the weak eye.[1] This is especially true of strabismus. Treatment is best when begun before the age of five years. If left untreated until adolescent or adult life, the weakness is not relieved, even though the cause of the trouble is removed by operation." Anyone who has the least influence in matters of cataract and strabismus would undoubtedly be guilty of serious negligence if he were to permit an afflicted individual to continue under such conditions for several years. As a matter of fact, no sensible person maintains in such cases that it is quite proper to wait a few years because the individual will *quickly learn to perceive properly*. One may possibly hold to such a position *in theory* but surely not *in practice*. The parent of an afflicted child should not delay unless he is indifferent to the inevitable consequences. To wait beyond the first few years of his life means permanent impairment to an individual. A lifetime spent after that generally brings no change.

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[1] By using the stereoscope, by bandaging the good eye, or by using drugs in the good eye.

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OUTLINE

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  2. Their Relation to Situation
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CHAPTER X

ACTION PATTERNS

A. *Introduction*

Of the several functional characteristics of man, perception and action appear first in his life. They are his earliest psychological ways of dealing at first hand with unlike objects of his environment. Man must perceive — see, hear, and feel — objects and he must act in a variety of ways with respect to them if he is to survive, achieve adequate satisfaction, and attain his desired goals. Generally speaking, man shows, in terms of these two functional properties, his strongest psychological resemblances to his subhuman neighbors. They, too, perceive certain objects in their environment and act toward them in several dissimilar ways. Man moves about his world perceiving objects and acting toward them. Perception and action, therefore, are not wholly independent functions.

a. Perceptual Products (Properties). In perception man may observe various properties of an object. These psychological properties are simple functional products. They are the direct resultant of the dynamic relations which man, as a living organism, sustains with his physical and chemical environment. These psychological properties are his perceptual contributions. They represent *one phase* in a total *causal* series of energy relations. They are absolutely determined — caused. They represent the several unlike changes which man produces in a total situation because he possesses different modes of perceiving. They are objective evidence of the fact that he sees, hears, tastes, smells, and feels.

The perceptual properties of the objects in a total situation may possibly be observed by a man without his immediately showing any behavior toward them. It may not be that kind of situation — it does not call for immediate action. It may call for thoughtful preparation. The commanding officer of an army

corps may slowly sweep the enemy's lines before him with his binoculars as he carefully studies his chances of successful attack and defense. He notes the size, position, height, length, and distance of the fortifications; he searchingly examines the terrain; and he observes the possible barriers to be crossed. He examines in great detail certain properties of the situation. He does not observe other possible details because many are not relevant. The situational needs determine the relevancy. The task in hand instructs him; it causes him to see certain things. He may intelligently reject, and so cease to observe all properties but one or two such as the height of a ridge or the distance across an intervening swamp. If he were asked, perhaps, about the color or the types of flowers he would most likely say he did not observe them. He had other things to see. Again, a spectator may sit idly in a window and note the ceaseless flow of humanity along a street: How it changes in rate of movement, in size, in loudness, and in color. Or, a nature lover may stand silent and motionless before some magnificent spectacle.[1]

Each of these individuals, however, may instantly cease being a spectator and begin, through action, to produce changes either in himself or in his environmental objects. He may use his hands, his feet, or his head directly in dealing with them; or he may use these indirectly through the aid of tools to bring about more effective changes. The general having finished with his examination may become a gesticulating, charging creature. The spectator may start waving and shouting at the crowd to cause it to change its course or to observe him. Or, the nature lover may bend his head and lift his voice in awe and reverence before the splendor of nature's handiwork. Each of these, upon becoming hungry, may possibly try to destroy his environmental objects in his search for satisfaction; or, upon becoming sleepy may leave his former tasks and build a comfortable place in which to rest and sleep.

b. Man Acts with Respect to Psychological Properties. In every case of meaningful behavior, man attempts to deal with some observed property or properties of an object or a situation. Carr points out in this connection that although an individual can react to any aspect of his complex sensory environment, yet

[1] The day-dreamer may sit or lie quietly for long periods partly perceiving and partly imagining. Much pleasure can be obtained just by perceiving without action.

he usually adapts to but one aspect at a time. He usually acts with reference to a particular object because of its apparent value to him, either directly or indirectly, as a means of securing satisfaction. His needs, desires, motives, expectations, and intentions primarily determine the nature of such values. His actions toward a perceived object depend upon the nature of his history, the conditions of his total organism at the moment, and upon his possible needs and conditions in the future. He may see some green, undersized berries and push them aside, but take some red, large ones; he may be frugal as a young man in order that he may have food and shelter when he is old; he may see a dark cloud rolling rapidly up, and run for shelter; he may hear a bell ring, and pick up his books for class; or, he may smell smoke from his car, and bring it to a hurried stop.

In every case, man acts with respect to one or more phases of an *object* in a situation.[1] Strictly speaking, he behaves toward a situational meaning. This is true even in case of some so-called reflexes. In the *wink* reflex (when an object approaches the eye), an individual apparently responds to the object but not to physical energy (waves). When the source of energy moves directly toward the eye the major change, physically speaking, should be an increase in intensity. But it is not a matter merely of intensity. For example, little children will not, at first, wink at an object which approaches them very rapidly. If the adult will place the fingers of both hands before his eyes so as to protect them, he will find that winking may be easily controlled. An individual does not respond, therefore, to the stimulus in its usual form of physical or chemical energy delivered to the sensitive structures of his organism. These are, we have said, unobservable and sub-meaningful phenomena.[2] An individual responds only to meaningful properties — to something perceived. These psychological properties exist in (constitute) the observed objects of a total situation because of the nature of his racial and personal history and of the way he is stimulated. And, as a result of his history, he acts toward them in a certain manner.

[1] Carr also remarks that, in general, changing, novel, and unusual conditions are the most effective stimuli to action. He also refers to pain from a splinter in the finger as being a motivating stimulus. These factors are not *physical* but *psychological.*

[2] Physically speaking, red is always red. It is a *wave length* and a *vibration rate.* The physicist is unable to observe a red wave. Moreover, neither he nor any other knows why it should have its particular properties of *length* and of *frequency.*

Perhaps the student's understanding here will be aided by an illustration. He may have read of an experiment in which Watson caused a baby to become afraid of a *live rat.* The baby was then found to be afraid of such objects as cotton wool, a rabbit, and a fur coat. Some students have thought that the young child actually *generalized* in a rational way from the live rat to the cotton wool and other objects. We do not assume, however, that an individual generalizes in this manner at so early an age. But it can perceive and act. In this particular illustration, we need merely to assume that the different perceived objects had the *same* psychological property. The child was afraid, therefore, of a property — not a live rat. If it had been fear of a *live rat,* it would not be understandable to talk about fear of a *large fur coat* on the one hand and of a small bit of cotton on the other. We readily see, then, that a single psychological property which produces the same kind of action may be a common characteristic of many objects (unlike in other respects) in the same way that one chemical property may be common to a number of different substances.

c. **Integration of Perception and Action.** Perception and action normally form a highly integrated functional pattern. An intimate relation obviously exists between them. They are different functions of the same nervous system. They are different ways in which the same organism deals with its environmental objects. If the student will consider for a moment the very close relation existing in his own life between perception and action where he fashions an object with his hands while being constantly guided through perception; or, if he will observe the constant shift in the actions of a boxer as he dodges the out-thrust glove of his opponent, he will better understand the extent to which perception and action may become related and dependent upon each other.

The course of psychological development of an individual, especially during his earlier years, is concerned to a major degree with the establishment of such functional relationships. An individual comes finally not merely to perceive many different objects in terms of certain properties, but to act in many cases toward them in a fairly specific and satisfying manner. A certain property comes to command a certain action. As a result of such functional integrations, man definitely increases his effectiveness

and enlarges his environment. He often changes it through action; and he then perceives it to be different. Within limits, we can undoubtedly say that the more able an individual is to perceive his world, the more able he is to act. Thus perception lays strong limitations upon action. Perceptual growth without a corresponding development in the ability to act might possibly make an individual wise in certain respects. He might very well be able to describe certain features of things in minute detail, but he would be rather ineffectual in a great many ways. Persons are often regarded as "knowing but not being able to do." While perception may at times run somewhat ahead of action in actual rate of development, the separation seldom becomes evident in the adult. We recognize, of course, that during their earlier years human beings can perceive (hear, see, taste, smell) certain objects for some time before they are able to order their behavior toward many other physical sources around them to any significant degree. The young baby will definitely reject very warm or cold or very sweet or sour food.

The very young child apparently does not perceive many objects. Or if it does, such objects do not elicit behavior because the organism has no preparation or instruction to determine its actions toward them. We stand opposed to the notion that the life of a young child is a "blooming buzzing confusion" into which it gradually introduces order. There can be no confusion if there is no perception of irrelevant things. The normal adult, at any one time, apparently does not see as many objects around him as he might under other conditions. If he does, he shows no action, because the situation does not demand action. It is not until an individual has become able to move about and to act effectively toward many perceptibly different objects that the possibilities for a normal psychological development exist. This fact is most evident in individuals who are born lacking two or more forms of perception (blind and deaf).

Very gross movements appear some little while before birth; and these especially characterize an individual for some time after birth.[1] As the internal regulatory basis of his psychological activi-

[1] The foetus of a cat has been experimentally removed from her body while immersed in a warm salt solution without injuring the umbilical cord, and kept alive for several hours. Under these conditions, mass movements (not reflexes) were observable.

ties increases in effectiveness, the various movements of an individual become more directive and controllable. With this increase in the degree of internal control, there appears a corresponding increase in psychological significance. With direction of an activity, comes more (and different) *meaning.* When a child can be guided by a particular form of instruction, it sees much that it formerly missed. It observes new properties of old objects or old properties in new objects. We assume that certain forms of man's behavior are wholly lacking in significance. They are similar in this respect to the functions of the liver or the colon. Some of these forms may possibly continue throughout life at this level. This is true of the simple reflexes (see below). In other cases, the actions of an individual may increase in significance until old age is reached. In their very simplest forms, these are known as random movements (see below). We wish to glance, very briefly, at each of these two types.

B. *Action with Non-psychological Preparation*

Reflexes. The nervous system of a normal human being is functionally prepared before birth for the execution of a few reflex movements. Thus we may discover in a human individual a degree of specificity between the particular way in which he is stimulated and the resulting form of behavior which is somewhat comparable with certain instinctive patterns found at the sub-human level. Both are to a major degree determined through heredity; and, strictly speaking, once they have started to run their courses, both appear to be independent of any guidance by the organism as far as wishes or intentions are concerned. The simple reflex is not psychological. Reflex is *largely* controlled by those neural mechanisms of the central nervous system which lie below the cerebrum. In this sense, it is like a function of the colon or of the lungs.

Reflex movement is a functional product. As evidence of this, let us consider the knee jerk for a moment.[1] When a normal person crosses his legs and permits another person to tap upon

[1] In this connection, we read that "the knee jerk, or patellar reflex, is a sudden, brief contraction of the *thigh muscle* that straightens the knee, and the only stimulus that can arouse just this response is a sudden stretching of that muscle, as by a blow on the patellar tendon just below the knee. The knee jerk is very exceptional in that it can be aroused by only one stimulus" (*32*, 230).

his knee, his leg will quickly jerk forward. He may clearly perceive (see and feel) this *movement* of his leg. The whole causal series which involves the stimulus, the functionally prepared nervous system, and the leg muscles, is not observable. Neither the subject nor the person who does the tapping *observes* the reflex in this sense. The latter stands much in the rôle of the physicist who studies a physical property in terms of what is done. It is quite possible for the subject intentionally to produce similar movements. This is true if the individual is permitted to perceive visually the hammer as it approaches his knee. In some cases, moreover, an individual cannot himself observe (non-visually) the reflex movements. This is true in cases of a broken back. It is also true in the normal individual — the pupillary reflex is a rather striking example. The pupil of the eye may contract or expand to a considerable degree under an increase or decrease in the intensity of the illumination. It may possibly occur in blind individuals. In no case, however, does the individual himself observe kinaesthetically these pupillary movements of expanding and contracting. He may possibly perceive them *indirectly* by means of a mirror or by a motion-picture camera. The student should understand that no one knows just how the pupil (and lens) is regulated. The bodily basis is somewhat different from that commonly involved in reflexes.

While we commonly speak of them as being forms of simple reflexes, we actually recognize the close dependence of the knee jerk and the pupillary contraction upon the integrated functioning of the nervous system. Like other forms of human functioning, they are undoubtedly affected by various factors. In an adult, for instance, the influence of such factors as the clenching of his hands (see Fig. 68), the gritting of his teeth, or the worrying about a physical condition, may serve either *to enhance or to retard the knee reflex.*[1] The memory of an emotional situation, the sight of a painful object, or the perception of drowsiness may also affect definitely the character (rate and amount) of the pupillary response. Reflex movements appear, therefore, as a resultant

[1] Two physiological terms may be applied generally to this enhancement and retardation, *namely*, facilitation and inhibition. During walking, for instance, the movement of the one leg seems both to inhibit and to facilitate the movement of the other. When the one moving member comes to rest, the other member begins to move. The movement of the one prepares the organism for the movement of the other.

of various functional *conditions* within the organism. Such conditions are definite causal agents to be placed with various forms of outside energy — mechanical (knee jerk) or light (pupillary reflex) — as determiners of behavior. If the student has ever had a very tiny object lodge in his larynx, he has surely discovered that his entire organism is completely concerned. In addition to crying, gagging, and nausea, convulsions involving the whole body may at times result from this very weak form of stimulation.

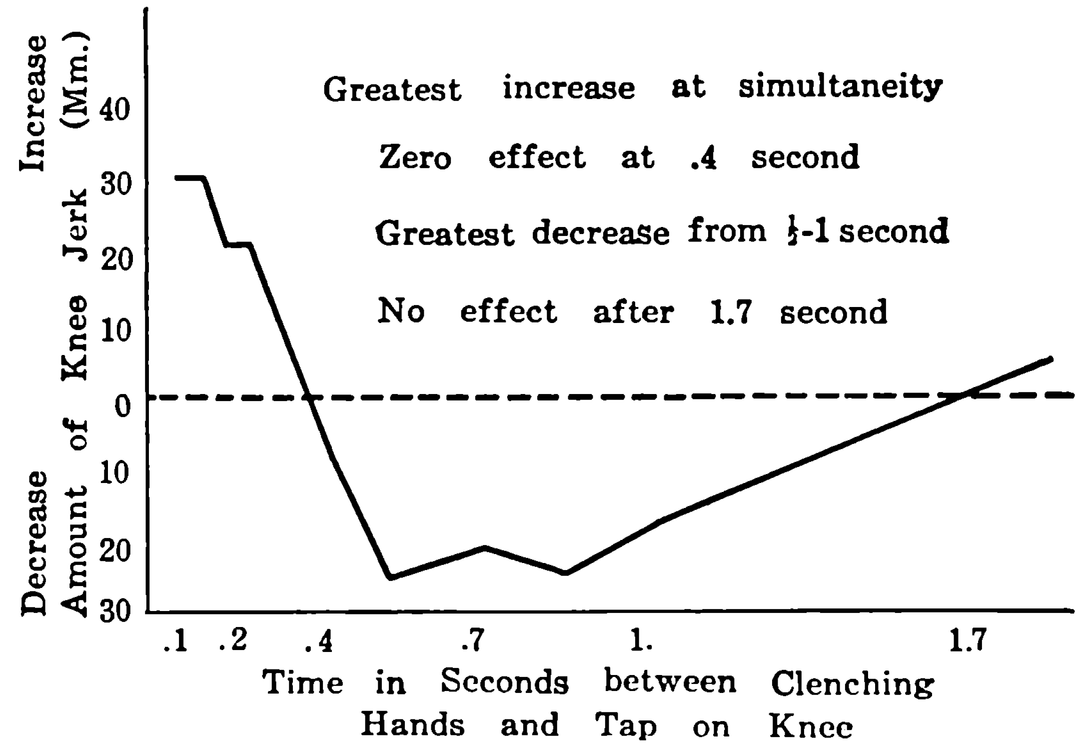

Fig. 68. One function may affect another.

A few of these partial[1] reflex patterns possess great survival value for the organism. Others appear, however, to play no significant part in the life of an individual. Among the former, we put those concerned with swallowing, eye movements, peristalsis, circulation, heart beat, and breathing. While a slight degree of personal regulation of these movement patterns may exist, nature has in general placed them beyond the effects of an individual's wishes and intentions. The rate of breathing under strenuous exercise, for instance, is less dependent upon a man's desires than upon the carbon dioxide content of his blood. Among the apparently non-useful forms, we cite the knee jerk, the extension and contraction of the toes when the sole of the foot is stroked, and the clinging movements of the baby. Concerning the last form, we know that a new-born individual may cling so tightly to any suitable object placed against the palms of its hands that

[1] We use the term "partial" because of the difficulty of classification. For example, an individual can swallow as a result of deliberate intention. He also swallows (possibly against his intention) when some object reaches the back of his mouth.

it will actually permit itself to be lifted bodily into the air, where it may possibly hang suspended for several seconds (Fig. 69). Such behavior in the infant has no personal or environmental significance.

This behavior reminds one of the tenacious grip of very young apes. Livingstone, for instance, has reported that such young creatures could be loosened from a man's beard only with considerable difficulty. And they will cling (clasp) tightly to their mothers a moment after they are born. At this level of life, however, this functional property certainly has great *biological* significance. The ability of the human infant to support itself by clinging usually tends to disappear some little time before it has developed to the walking stage. Clinging behavior of a wholly different sort may be observable, however, throughout the life of an individual whenever he perceives himself to be in danger of falling. Since it is no longer reflexive,[1] this behavior possesses psychological significance. As long as it is purely reflexive, its significance is necessarily biological.

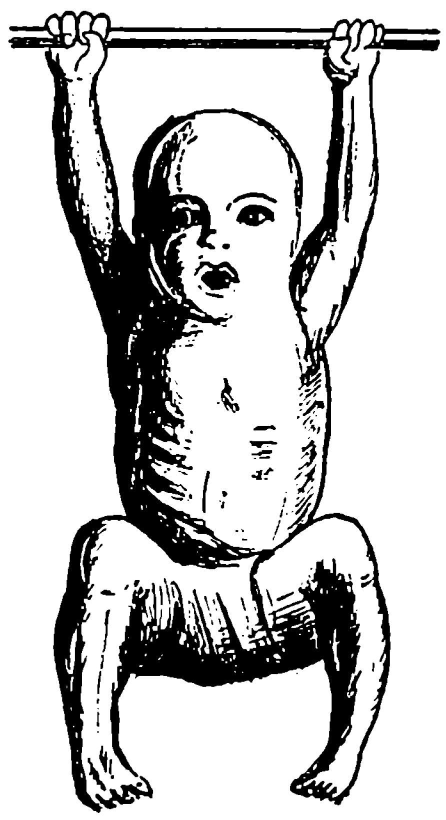

FIG. 69. Why should such functions disappear in a few months?

Some scientists hold that the many dissimilar types of action which characterize a human individual during his entire life, may be adequately considered as being combinations and patterns of his simple reflexes. This type of approach is identical in principle with that of those who would describe meaningful perceptions, for example, as being combinations or patterns of meaningless sensations. The primary virtue of such descriptions is assumed to lie in their simplicity. But this simplicity, as we have suggested, is evidently secured at the expense of our understanding. The acceptance of such an explanation entails considerable loss without appreciable gain.

No one can understand human life as long as he clings to reflex. The evidence is quite clear. There are, for instance, the simple reflexes of the arms and the legs. These undoubtedly run their courses just as automatically and as mechanically as do the reflexes

[1] In terms of the stimulus and the character of the behavior.

of the pupil or of the alimentary canal. The critical individual will easily discover that it is quite impossible, once it is started, to stop a reflex while it is running its course. He will accordingly find that when the knee jerk, for example, has been started on its way it automatically carries on.[1] But he will also find this to be true: His hand, regardless of reflex, can be advanced toward an environmental object in the near or far distance at many different rates and angles; moreover, it can be suddenly or slowly stopped at various distances and in various positions; and, finally, while moving it can be turned in many directions.[2] Or, his leg, for various purposes, can be moved and held in a great many different directions and positions for varying lengths of time.

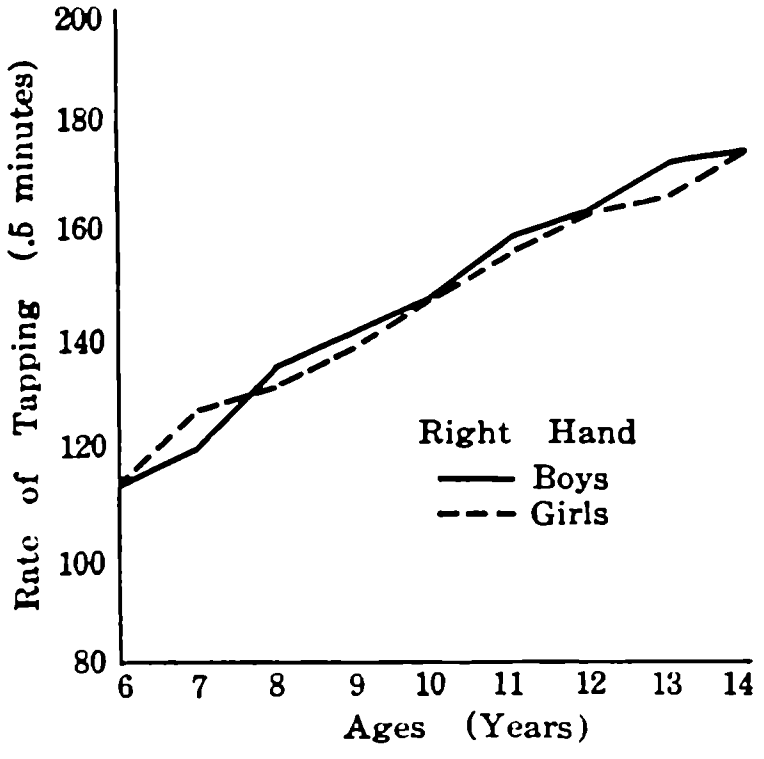

Fig. 70. The sexes show a striking degree of uniformity in development.

We are forced to recognize that, as far as actual observation is concerned, such directive arm and leg movements have essentially this one feature in common with certain reflexes: The same organism or the same gross parts of the organism are involved. Other significant features are different. It is understood that the stimulus in these two cases must necessarily be *very* dissimilar. Thus in *seeing* a football and in *kicking* the leg and foot toward it at the proper moment in order to achieve a desired end, the stimulus is, of course, like that to be found in all such visual cases, *namely*, *light energy* which acts upon the retina. But the stimulus *is not a football.* This is a perceived object which has certain psychological properties, *namely*, size, shape, color. In the quick extension — kick — of the leg and foot in the case of the ordinary knee jerk, however, the stimulus is a form of *mechanical energy* which acts upon structures (perhaps undifferentiated nerve-endings) located in the region of the knee-cap. Moreover, the rate, the extent,

[1] We wish to point out one more significant fact. In deep sleep, the knee jerk disappears. Yet individuals can move their legs quite freely in sleep! They are not paralyzed, merely because the reflexes as represented by the knee jerk have disappeared.

[2] See Koch, H., "A Study of Hand Preference." *Genet. Psychol. Monog.*, 13.

the time required for the initiation, as well as the controllability and modifiability of these leg movements (kicking), are utterly dissimilar in the two cases.

We wish to emphasize, therefore, the impossibility of considering, in an understandable manner, the diverse action patterns of man's everyday life as being derived from his simple reflexes.[1] In addition to those just mentioned, there are other significant differences. The latter forms, for instance, are unquestionably inherent in an individual. Observation of pre-natal stages of animal forms shows that reflexes gradually develop out of mass patterns. At first, each form of stimulation has widespread functional effects; only mass patterns are at first observable. The specialized (semi-independent) movements of the reflexes appear later as the organism gradually develops. Among the members of a given species, a certain type of reflex may be expected to differentiate itself at about the same time. Among human beings, sucking normally appears at about the same time. In prematurely born individuals, sucking is usually absent. But swallowing is present, so that it is possible to feed such individuals by dropping milk into their mouths. Thus we see that sucking and swallowing appear at different times and are distinct in operation. Of course, everyone knows that a child may suck without swallowing. Moreover, the average date of appearance may vary among different kinds of reflexes.

Reflexes, being products of maturation or bodily development, normally run their course independently of the individual's direction and at a wholly submeaningful level. They are fixed by nature in the beginning. And, regardless of the intensive training that man commonly undergoes during his lifetime, no learned change occurs in this relation between a particular form of stimulus and a particular form of movement. It cannot be *trained* or *educated* away, although it may disappear (grasping, etc.) as a result of maturation. That is, the knee jerk is not educated out of an individual through practice. When we consider some of these commonly known facts as well as the significant rôle played by an individual's intentions and purposes in the actual determi-

[1] Herrick remarks that the simple reflexes are not the elementary units of behavior, and the actual conduct of animals and human beings is not fabricated by monumentally piling up of simple reflexes (chapter on Neural Integration. *The Problem of Mental Disorder*, edited by Bentley).

nation of his daily behavior, we may well be surprised to read in a discussion of chain reflexes that the life of a human being is full of such chain phenomena among which are singing or whistling a tune, reciting from a favorite poet, scribbling one's autograph, dancing, or speaking the usual phrases of English idiom (9).

If we deny the simple reflexes such a dominant place, where shall we turn in order to secure an adequate understanding of the basic materials out of which an individual's ordinary action patterns, e.g., kicking football, are drawn and molded? There is, we suggest, a very fertile and obvious source of such materials. The source is inherent in the organism; but the various action patterns which arise out of this source are acquired. We turn to the infant's random movements.

The very earliest post-natal action patterns of a human being are extremely diffuse and almost wholly non-specialized. The behavior is very general. There is no discoverable relation of a specific nature between particular energy sources and manifested behavior. Of such random activity patterns a psychologist remarks in part that they appear to lead to no result of any consequence, except that the exercise is good for the child's muscles and brain. *They are no doubt satisfying on their own account.* When regarded singly, the movements are well-coördinated flexions and extensions of the limbs. They do not produce any definite *change in external objects*, and so appear meaningless to adult eyes. Since it is impossible, he adds, to specify the stimulus for most of these movements, they appear to be spontaneous. Perhaps the child's motor machinery may be so ready for action that almost any stimulus is enough to set it off (Woodworth).

C. *Random Movements in Infants*

When a very young child is pinched, pulled, pricked, or squeezed; when it is damp, cold, or hot; when it has been without food or water for some time; or when it is not sleepy, or hungry, or thirsty, a large portion of its organism may become involved in action. It squirms, pulls, twists, kicks, throws its arms about, opens and closes its hands, screws up its face, mouths, grunts, gurgles, and cries.[1] Such diverse activities cannot possibly be

[1] Some excellent studies on infants have been made at Ohio State. Irwin has described a few minutes of intense infantile activity. The infant maintains continuous body movement with such speed and excessiveness that an observer, using

regarded as being forms of simple reflexes, unless the term is stretched so widely as to make it quite worthless. There is no known describable stimulus which can be assigned to the gurgling and cooing and kicking and squirming. When there is no stimulus whatsoever, we are not helped much in our thinking by sticking to reflexes. What is true in the infant is true in the adult. The violent escape movements of his legs and the rapid thrashing of his arms when an adult's nose and mouth are tightly held (where there is no other form of stimulation) cannot be regarded as being reflexive without doing violence to the descriptive value of the term. Since the *same* form of physical energy (stimulation) may repeatedly result in a very large number of very dissimilar actions which are wholly unrelated to each other except that all issue from the nervous system, and since *unlike* forms of stimulation may be followed by the same type of vague, undifferentiated mass action patterns, the reflex concept becomes inadequate. Its necessary specificity is quite lacking. At times, then, the diffuse movements of the young child are strikingly like those of a mature individual. The former naturally are neither as forceful nor as coördinated as the latter. In both cases, the several actions run on seemingly without particular direction and without any orderly relationship being manifested among them. The adult may thus show behavior patterns like that of the infant; that is, he may show *mass* actions.

a. Significance of Random Movements for Later Behavior. In the random, diffuse behavior either of the pre-natal or of the new-born child we discover a way that leads directly and understandably to the behavior patterns of the adult level. We cannot assume, therefore, that the course of individual development begins at an infantile *reflexive* level of behavior and ends finally at an adult *non-reflexive* level. In fact, the difference between purely *automatic reflexes* and *directive behavior* is actually no greater in the case of the adult than the separation between reflexes and random movements is in the infant. The specialized reflexive movements of the infant may persist unchanged through life as anyone can determine through experimental testing. But the

a specially devised code, cannot keep up with it. It squirms, twists, bends. Its back arches, its hips sway, and its head rolls from side to side. The arms slash vigorously and the legs kick in exaggerated extensor thrusts or are flexed sharply at ankle, knee, and hip. Hands, arms, fingers, legs, and toes are in continuous movement. Sucking and smacking sounds frequently occur, while loud crying is usually coincident with mass activity.

non-specialized mass behavior of the early days becomes the directive, specialized behavior of the later years. In this case, individual development brings great changes. Now, the way which we take *here* in our attempt to understand the action patterns of adult human beings does not force us to change horses — from reflex to non-reflex — in mid-stream. We accordingly recognize (1) that out of the *mass* patterns of the unborn individual gradually issue the specialized patterns of the several reflexes. These forms partly disentangle themselves from the undifferentiated mass base. They emerge and then assume a fixed form. That hereditary factors normally do this separating is clearly evidenced by the fact that the various reflexes regularly appear about the same time in all individuals of the same species. But such reflexes never become completely separated. This is shown by the plain fact that that which goes on in other regions of the organism definitely affects reflexive behavior. Gritting the teeth, for example, will affect the knee jerk. We also recognize (2) that out of the gross *mass* movement patterns of the post-natal period of individual development gradually issue the manifold specialized patterns of *voluntary* actions. These, too, partly disentangle themselves from the mass base. They emerge and assume a modifiable form. This is commonly known as learning. But all such patterns are very definitely related; they never become completely isolated. Each has its roots fixed firmly in the common undifferentiated mass basis. Under certain conditions, each may return partly to the earlier and more diffuse form. Thus under very unusual excitement, haste, emotion, strange situations, and the like, the specialized patterns may sink into their mass basis. Behavior is diffuse and less directive. The organism is not sustained. Generally speaking, reflexive and non-reflexive behavior patterns are related in so far as they have a common cause or origin, *namely*, mass patterns.

b. Major Biological Conditions of Random Activities. The diffuse behavior of the child has no discoverable biological significance. It certainly possesses no immediate *racial* utility; nor does it have any apparent vegetative (physiological) value. It again differs in this respect from certain reflexes. It does possess great value, however, in that it furnishes the raw materials — the genetic basis — for that which comes later to make human life so significant; which lifts it above that form of life found, for

instance, in certain diseases where the ordinary reflexes still function but where the unique characteristics of human living are missing.

This diffuse kind of behavior apparently exists as a result of the two very general intra-organic conditions. (1) The materials which compose the structural patterns of a human being are extremely unstable; (2) and the nervous system of the child tends like all living things to function as a unit. As a direct result of this instability, we find that physical or chemical energy applied to any receptors raises the whole nervous system to a functional level. And when it has been started, it seemingly functions throughout its entirety. But we do not assume that specific forms of energy must always come to the organism from the outside in order for many patterns to appear. On the contrary, we assume that the normal and universal processes of life, growth, and development adequately provide for certain types of these patterns. When the inherently established balance of life processes is disturbed, we find certain mass patterns (hunger, colic, thirst with their many attendant properties). When the balance is established as in normal health and satisfaction, we may again find mass patterns such as are concerned in contentment and peace. The one is, of course, as much caused as the other. Neither has been reduced to describable forms of external stimulation. Both types may issue, we suggest, from an inherently determined biological condition — a level of organic functioning — which involves the organism in general and the nervous system in particular.

In the beginning, no significant direction of particular activities (hands, feet) toward particular objects can be discovered. The behavior of an infant occurs as a result (a) in part of the nature and the pattern of its protoplasm and (b) in part of the changes induced in it under stimulation and growth. It cannot help doing what it does. It has no personal history to influence its behavior. It has certain needs, which are indicated in the very beginning by what it does. It definitely selects and rejects (crying, spewing, swallowing) that which comes to it. In every case of perception and action, however, it responds to properties of objects and not to stimuli. It definitely responds to warm objects, to cold objects, to painful objects, to bright objects, etc. It also comes in time to respond in new ways to many new properties of objects.

It should be understood that a child does not respond to *stimuli* during its infancy and to *objects* during its maturity. There is no biological provision for any shift of this sort. The infant does not possess strange or unusual abilities not found in the adult; it responds to certain properties of objects. When further psychological development has occurred and the child (youth) has reason to do so, it will observe other properties and act with respect to them in a non-infantile manner. Because of its greater development at the time of its birth, the behavior of the subhuman furnishes a better illustration of this truth. One does not find, for instance, that the *young* of the man-like apes responds to all objects in a way very different from those of the fully grown forms. As a matter of fact, an ape during the time it is being born will actually stretch out its hand and grasp any small object within reach and by so doing apparently help to remove itself from its mother! If it is allowed at this time to grasp a support, it may hang suspended by *one hand* for as long as thirty minutes. Upon being placed against its mother, it instantly clasps and clings tightly to her.

c. Random Activity Is Not a Form of Maladjustment. With these several biological facts properly understood, we wish to point out the difficulty of considering the random behavior of the young child or the adult as being some expression of a maladjusted condition. We exclude all reflex behavior from our discussion for the very obvious reason that no one regards reflexes as being capable of maladjustment. We do not say, for instance, that knee jerk is maladjusted, although it may partially or completely disappear under shock, disease, etc. The interpretation of human behavior in terms of *adjustment* is often as lacking in significance as the common notion of some sex instinct in terms of which man must be properly or rightly satisfied in some particular manner. If an observer, for instance, were fully acquainted with the *ends* of a human life, or if he knew the direction of an individual's activities, or if he knew the precise goal toward the attainment of which an individual is definitely disposed, or if he knew how an individual *should* develop, he might be able to evaluate intelligently the behavior of a human being. The student must be guided in his thinking by this fact: Every activity of a human being, infant or adult, is absolutely caused. The particular result in every case must necessarily follow the cause, and there

can be no maladjustment whatsoever between cause and effect.[1] If the cause were maladjusted, the effect would be maladjusted. But a maladjusted cause is something with which science is unacquainted. We usually recognize in science that some undesirable cause may possibly exist and we may accordingly seek to remove the cause in order to remove the resultant effects.

Let us consider an illustration. Many "playful" activities appear in many animal forms and in young children, either when *isolated* or in *groups*. Such activities are non-utilitarian and non-directive. An animal or a child, we say, "just plays." A child skips, hops, jumps, runs, and rolls around for the sheer pleasure that activity itself affords. Play, then, at *any* level of life can scarcely be regarded as a form of maladjustment unless one assumes that *activity* itself is unnatural while *inactivity* is natural. We must sensibly recognize that many activities of a *psychological* sort go on quite as naturally as do many biological processes such as *growth* and *development*. But biologists do not regard the physical growth of man, animal, or plant as being a form either of adjustment or of maladjustment. Notwithstanding these obvious facts some students apparently hold that the conditions of maladjustment lead directly into random, excess activity. Concerning playful activities in the child, one individual writes in part that well-rested musculature, supported by tonic conditions of respiratory and circulatory organic systems, induces in any healthy baby the random slashing and kicking and finger working that is denominated "play" (9). But it is common knowledge that sickly, frail children also play. Even those who die as a result of certain diseases such as tuberculosis, in which there is a slow decline, often continue to play until they become so feeble that they can move only their arms and hands.

d. The Psychological Importance of Non-specialized (Mass) Patterns of Infants. In the utter *impartiality* of the random actions of the infantile level lies the actual key, we suggest, to an adequate understanding of both the diversification and the specialization of behavior which occur during an individual's post-infantile years of development. The baby's repertory of actions is at first extremely limited, but it unquestionably gives everything it can give to any object which strongly dominates it.

[1] Of course, it is a different matter if one thinks of maladjusted behavior as being some form of which *he personally does not approve.*

Within these diffuse mass actions of the infant reposes the fertile basis of many precise behavior patterns of the adult. The normal course of psychological development will finally bring the infant to full maturity with many unlike action patterns fairly permanently established toward various environmental objects. From the very simple, in this case, will have come the very complex; and out of the very generalized will have come the very specialized forms of action. From the nature of the large changes which mark such individual development, man can dimly discern in a very general way the course followed by the race in its evolution; for it is universally assumed that the more simple forms — structural and functional — preceded the more complex forms of life, and from the generalized came the specialized types of life.

e. Specialization and Development. When an individual has firmly established his specialized ways of acting with regard to the properties of certain objects, further development along new lines is less likely to occur. The one, fixed way often tends to remain and to hinder the formation of others. Such old ways may definitely prevent an individual from establishing new paths of development that might possibly lead him to another level of achievement. Economically speaking, older men are recognizably less versatile than younger men — a truth that is repeatedly forced upon every thinking individual during each period of economic depression. Youth is unquestionably the time for growth — it is the time for building up. Middle age or maturity is apparently the age for holding tightly to that which has been established. And old age is seemingly the period for tearing down and letting go of many established action patterns. If, during his youth, an adequate preparation for life is so laid by an individual in the form of attitudes that he is receptive to the *new*, tolerant of the opinions of others, reluctant to form final (finished) judgments about matters, and inclined not to take himself and life too seriously, he may definitely retard the encroachment of middle age with its attendant conservatism and its resulting conflicts. It is surely not by sheer *magic* that some men prolong their youth, psychologically speaking, into that period of life where the past usually becomes cherished largely because it is old.

Functionally speaking, if man had become specialized quite early in his racial development to the same degree as his subhuman neighbors, he would have failed to attain his comparatively high

level of psychological development. It is indeed fortunate, therefore, for the advancement of the entire race that human beings during their early years are so helpless in many respects and so utterly *impartial* in their actions to the objects of their environment. Man begins very slowly, it is true, but he ends finally by going very far. This is far better than starting very quickly and stopping shortly. Inadequacy as an infant with much adequacy as an adult is certainly a far more desirable state of affairs for man's future progress than is adequacy at birth with inadequacy at maturity.

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CHAPTER XI

ACTION WITH PSYCHOLOGICAL PREPARATION

Each activity of human beings is very definitely determined. This determination may issue directly from conditions which have been established by the race and handed down to each individual by means of heredity. Or, it may arise as a result of the personal history of man in terms of his relations with the various objects of his environment. A most outstanding characteristic of such determination is the ease and the uniformity of action. Generally speaking, the stage is usually so clearly arranged or prepared that many behavior patterns of an individual arise again and again in a strikingly similar manner. We actually come to expect the appearance and the reappearance of certain action patterns in individuals with a degree of assurance somewhat equal to that with which we anticipate the return of the seasons. As a matter of fact, we usually place a heavy premium upon such uniformity. This is particularly true in many important matters of life.

As a result of this expectation, a great deal of time and energy and enormous sums of money are expended annually in the preparation and training of developing individuals in such a way that they will come uniformly to show action patterns which are socially desirable. Civilized society is not content to leave the necessary preparation of an individual's actions to chance. Our educational institutions exist, in part, because society has discovered that it is economically and socially impracticable for an individual parent to prepare properly his own children for their later participation in their larger social relations. Educational institutions exist because familial institutions are wholly inadequate as preparatory agencies. Regardless of their possible willingness to aid and instruct, neither the parents nor other social mentors can always stand at the side of an individual in order to guide and to sustain him adequately in his various relations with life. For a good many years, his activities are definitely ordered by others. They

prime him for the situations which he may possibly face. Much that an individual does as a child under formal instruction becomes significant only when considered in terms of his future. His parents and others go as far as they can with him along the way of life. A time necessarily comes when he must depend upon his own resources. Under these conditions, however, his functional preparation is not over. In fact, it can never be wholly finished as long as an individual lives, moves about, and finds new or changing environmental objects and situations. It simply shifts from the parent to the individual himself.

A human being is definitely prepared in the two following ways at an early time for later functioning: (A) by others, and (B) by himself. The environment of an individual contains both human and non-human objects. It comprises the extra-organic sources of the *determination* of his psychological functions. In addition, there are the intra-organic sources of determination. Although the sources of his determination may therefore be quite different, in every case a human being is being prepared — he is being taught. And the actual scene of the preparation is always intra-organic. It has, moreover, to do with functions and not structures. In this connection we recall a statement by Gibbon, the historian. Every person, he remarked, has two educations — one which he receives from others, and one, more important, which he gives himself. Both aim at the same goal, *namely*, the psychological preparation for effective living. We do not, of course, regard an individual as receiving an education. We regard education essentially as we do growth. It is a way of development. Everyone is educated.

A. *Extra-organic Preparation*

The preparation of an individual by others predisposes him toward carrying out many unlike forms of action of which the vast majority are purely social. Parents, teachers, overseers, comrades, salesmen, propagandists, and reformers all seek to incline man's actions along desired lines. Attitudes of courtesy, coöperation, and obedience; ideals of politics, ethics, and religion; and standards of honesty, dependability, and punctuality are taught the individual during his more formative years in the expectation that they will later express themselves in his relations with other human beings. At the same time a great deal of information, many set rules, various sound methods of thinking, and effective types of industrial

technique are established in an individual in order to induce in him a greater degree of self-sufficiency and personal independence. In all these cases, language is unquestionably the major mode or vehicle of *instruction or preparation.* In this particular way, human beings differ tremendously from subhuman forms. Among the latter, another and less efficient form of preparation must necessarily be used. A human being who cannot easily be instructed by language is placed at a very decided disadvantage. In this one way, at least, he approaches the subhuman level.

a. A Laboratory Illustration. The psychologist who works experimentally with human subjects in the laboratory very quickly discovers the necessity of using very strict forms of functional preparation. He soon finds that lacking one form of preparation his subjects will immediately find another. By means of a common instruction he is able to establish a very important type of *control* over the laboratory behavior of his human subjects. This fact is brought out quite clearly, for example, in the ordinary reaction experiment. In such studies an attempt is made to measure the amount of time required by an individual to carry out some simple action, such as moving his finger to press a key, or speaking a word when a certain object, following a preparatory signal, is presented. The task may be essentially like that of the runner on the starting line, who understands that he must start moving as quickly as he possibly can after the gun is fired if he is to do his best.

1. *Reaction Experiment.* The individual who serves as a subject to be tested or studied in the laboratory must respond as quickly as he can when he perceives the proper property or object — visual, tactual, or auditory — for which he has been prepared. The organism, therefore, is precisely *predisposed* for the carrying out of some *particular* action when a particular object is perceived. The student can readily understand that the product in such cases is very definitely predetermined. The individual sits with his finger upon the key in anticipation of the object. He is waiting, in this case, for a particular object — not just any object. His functional condition here is exactly like that which exists in thousands of cases in his daily life. In this state of anticipation we definitely assume that the action has already started as far as the neural pattern involved in action is concerned. The individual is actually in the first stage of producing an action. His nervous energy is spilling out to the muscles of the arm and finger as well

as many other members as a result of which they are partially contracted to give rise to the psychological properties clearly observable in the body of the individual. It is tense and semi-rigid. Often when this tension is unusually pronounced or when his anticipation for a particular object is momentarily changed by perceiving or thinking about some other object, the individual who was set, for instance, for a particular sound object may "jump the gun" or he may not move at all. If he hears anything, such as a cough or a creaking board, he may move. He may also respond before the object of his previous instruction is actually perceived. In this case, the intra-organic conditions of the individual are such that

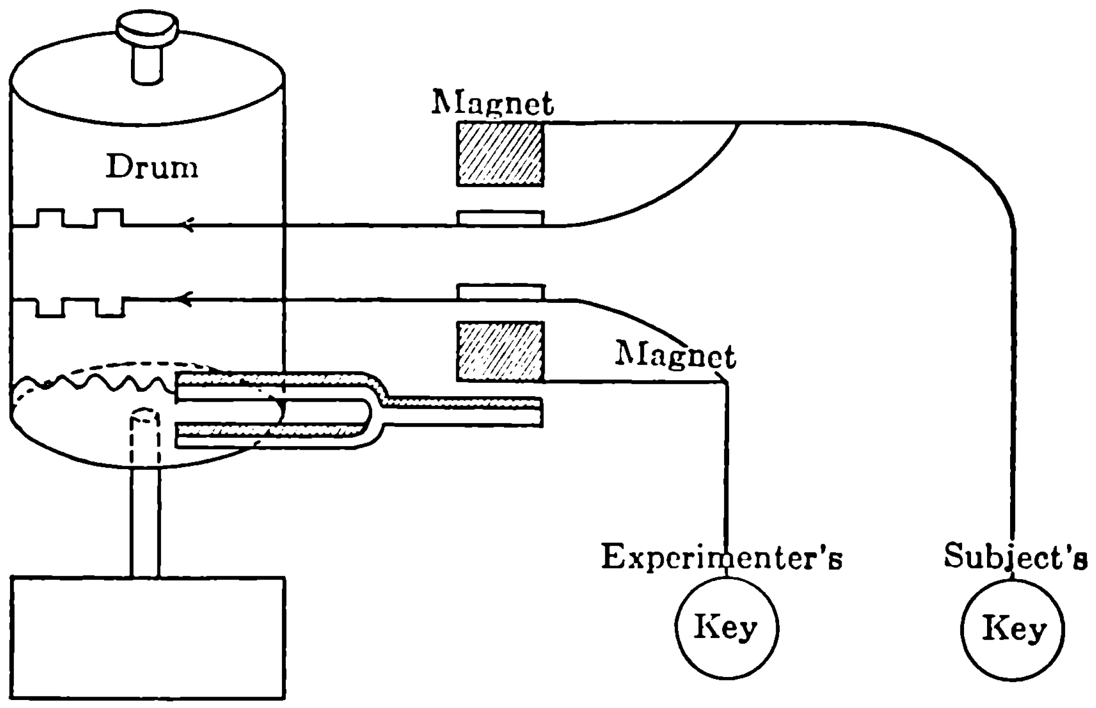

Fig. 71. Apparatus used in measuring speed of reactions.

the preparatory signal itself releases sufficient energy to produce action. The subject will often report that he momentarily forgot, or that he was too tense, or that he acted before he thought. The relatively small number of these cases offers good evidence of the significance of the particular preparation. Under the usual conditions of such experimentation, some form of recording device (see Fig. 71) is used to measure time. The experimenter presses a key when the stimulus is presented and the subject presses another key as quickly as he can after he perceives. In this manner, a psychologist may measure to a fraction of a second the time required for some action to follow a perception. Such activities are accordingly regarded as being functional products of man. Like other products, they give an understanding of man's functional properties. Here, as elsewhere, science studies an object in terms of its products.

2. *Some Data.* In the case of visual perception the average time required for the completion of an action varies from 150 to 200 thousandths second; for auditory perception, the average time ranges between 120 and 180 thousandths second; and for touch it is a few thousandths less than for audition. Such times are normally required when the subject is definitely instructed to think about the environmental object; the emphasis is upon that object. When he is instructionally prepared, however, to perceive his arm and fingers — to notice the tension in them — and to think particularly about the movements involved in pressing the key, the time may be $\frac{1}{10}$ second shorter.[1] In all these cases, as a result of uncontrollable functional changes occurring from moment to moment in the individual, there is considerable variability from time to time in the speed of action. There are momentary shifts both in what he is perceiving and in his intentions; and there is often an increasing degree of fatigue, discomfort, restlessness, and indifference. Such momentary shifts, as we have previously remarked, cannot be prevented. They issue from the inherent nature of the organism. Moreover, when the time interval between the ready signal and the observation of the stimulus-object is varied, the reaction time also varies. The latter appears to be both shorter and more uniform when the preparatory interval is about two seconds in length (see Fig. 72). A change in any one condition is usually accompanied by resulting changes in the functional product.

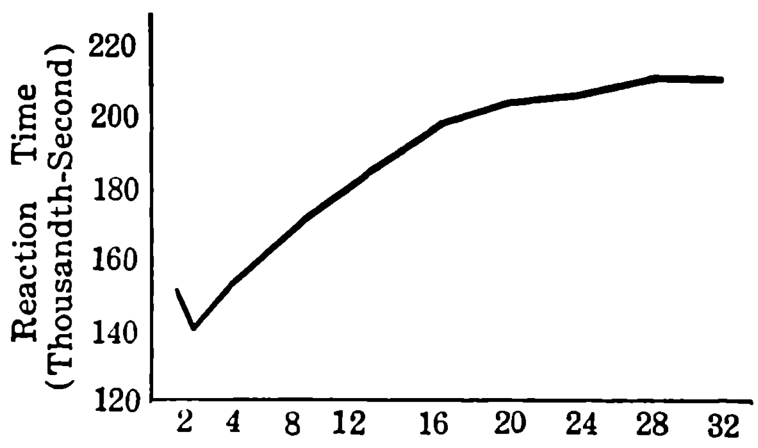

FIG. 72. Reaction time is affected by length of preparatory period (Woodrow).

3. *Some Modifications of This Method.* Various modifications have been made in this simple method of studying the influence of preparation upon the speed at which human beings act with respect to perceived objects. The reaction times of a number of automobile drivers have been measured by using an arrangement of

[1] When the individual anticipates (thinks about) the stimulus-object, the action is commonly called *sensorial*. In these cases, the individual very seldom "jumps the gun." When an individual perceives his arm and thinks about what he is going to do, we speak of *muscular* action. While these times are very short, *they do not equal those of the simpler reflexes, some of which may require only five hundredths second.*

two pistols so placed under the car that the times of their firing could be determined by the marks of their discharges on the pavement. The perception of the first pistol started the necessary actions of stopping the car. The second pistol fired when the brake was actually pressed. The average time required for movement under these conditions was about fifty hundredths second. When the instruction remained constant, this time did not vary significantly for different rates of speed. A lesser degree of variability appeared among the persons showing the shorter reaction times.

4. *Perceptual Discrimination and So-called Choice Action.* In such general studies, various changes have also been made in the perceptual conditions in order to throw more light upon the nature of some of man's functional properties. In these cases, red, green, and yellow lamps, for example, may be placed before the subject, who is instructed to respond to a perceived "change" in *one* of these objects. He must discriminate. Or, changes (complications) may also be introduced on the side of the particular form which an action is to take. For instance, a key may be provided for each hand, and the individual may be instructed to act with his left hand to the perception of one colored lamp and with his right hand to another (differently) colored light. In either case, whether it be *discrimination* reaction or *choice* reaction the amount of time required is greater than under simpler conditions. The situational — instructional — conditions in these cases are slightly ambiguous; they have an "if" in them. As a direct result it is quite impossible for the organism to establish a single, one-faced determination here — one which is as unequivocal as that which characterizes the simpler reaction. The introduction of the "either-or" intention demands that the organism secure a more specific perception for action than would otherwise be necessary. In such cases, it is no longer a matter merely of perceiving a *change* in a single property of an environmental situation — for instance, a change from *no light to a light* in a uniform field. At its very simplest, the task involves the perception of a possible change in two visual properties — either the one color or the other of two objects. The introduction of an "if" is followed by a necessary increase in the time required for the perceptual-actional pattern to be completed. The resolution of this "if" situation is characterized, physiologically speaking, by a slight delay in the final release of the necessary energy from the brain to the muscles of the arm to produce the

specified movement. The brain presumably works just as rapidly as in case of the simple reaction, but it has a more difficult task in such cases.

The student should realize that such studies as these, when properly understood, throw much light upon man's fundamental psychological functioning. Functionally regarded, the man in the laboratory is identical with the man on the street; only their forms of preparation or instruction are usually different because their problems are different. But in either case, their perceptions and actions are cut out of the same piece of cloth. Such studies show that perception and action, for example, are simply different ways in which an organism, with a particular history, functions in a particular situation. An individual is always functioning. Thus a living organism differs from a non-living substance. But the particular form may vary; and it may be determined in various ways. The individual, we say, perceives an object. Following a *longer* or a *shorter* time, and depending upon his hereditary make-up and his preparation, certain movements are produced. The action must necessarily have started (the necessary or basic conditions must have existed) before the object was perceived in exactly the same way that the perception started (certain necessary conditions existed) before the stimulus energy reached the organism. The matter of functional preparation is very important if for no other reason than that it is *always with us*.

B. *Intra-organic Preparation*

In addition to this general form of instruction by other human beings, man constantly prepares himself for functioning. This second way seemingly produces in many cases a greater degree of social and personal self-sufficiency than does that of the first. Human beings repeatedly face life situations and discover directly, without being told, what is to be expected of them under various conditions. It is duly recognized in such cases that a closed mouth and open eyes may possibly save a naïve individual — one who lacks the sort of preparation required by the particular situation — no little amount of pain, censure, misunderstanding, and explanation. Those persons who have faced many different situations and observed closely in them appear, as a rule, to be able later to find their "way about" without much trouble. As some would say, "They know all the questions, and they have all the answers."

Men, we say, "learn through experience." The American pioneer who went alone into the wilderness had, without the aid of any other human being, to prepare himself for effective action. There was no one to take him by the hand and to point out for his benefit and understanding the subtle signs of the enemy or the ways of subhuman forms. His functional preparation was gradually acquired here by close and silent observation. Much of his education accordingly came directly through self-instruction. Under stern necessity, he finally became functionally primed to a remarkable degree along certain lines. He was self-taught. He could, for instance, turn here and there on the very faint trail of a man or of an animal. The visual perception of a slightly turned rock or of a bent twig finally became sufficient to release and sustain action. In the same way and quite to the same degree, the very socialized individual observes many things which a less socialized person misses. A great deal of training for meeting life situations necessarily comes to everyone in this manner. Each of us acts in certain ways under certain situations because they have taught us — silently, it may be true, but very effectively. The burnt child shortly comes to avoid the fire.[1] The hungry animal quickly comes to know its own feeding place.

The Rôle of Imagination and Verbalization in Preparation. An individual may also prepare himself through imagination or verbalization to function more adequately. If he imagines a situation which he must finally face, the intelligent individual may consider several possible forms of actions. He may say to himself: "If I am asked this question, I'll say this" or, "When I see him, I shall walk right up to him" or, "If he moves over there, I'll move here." By covering in imagination every possible condition or contingency, the individual may actually be primed or prepared for effective functioning long before he perceptually faces the situation. That this is a very excellent method of preparatory

[1] The avoidance rests upon the child's *observation* of the painful properties of the flame. Until this property appears, the child may be assumed to observe other properties of the candle, for example, its brightness. Some children change quickly in this way. Hull reports one child that extinguished a candle with its hand. The next day it refused to touch not only the candle but a lighted lamp bulb. When the bulb was unlighted, however, the child immediately took it. Other children require longer time. To break a dog of egg-sucking, one heats an egg or fills it with cayenne pepper. The dog takes it in his mouth and one then holds his mouth closed so that he has plenty of time to observe. Usually one application is sufficient to break this pattern.

procedure will doubtless be admitted by every individual who has suddenly been caught "off guard" by some unexpected situation. It is, indeed, very disconcerting to find oneself stammering like a schoolboy, or hedging awkwardly in a situation, while one strives desperately to produce some action or solution adequate for the occasion. Being psychologically forewarned in all situations is surely being forearmed.

Men who have acquired enviable reputations as being able speakers because of what they said upon occasions in which a previous preparation was seemingly improbable have, at times, frankly explained that they really were prepared. They had deliberately prepared themselves for a number of different types of occasions. When a particular occasion appeared, they were functionally primed. Any ambitious individual can, at his leisure, prepare himself in this manner so that he is adequately equipped to speak with more ease and greater fluency upon a fairly wide range of topics and problems. It is indeed difficult for most individuals, unless they have had some adequate preparation, to think and to speak coherently and effectively under the usual excitement and distraction attendant upon facing a group.

It has frequently been pointed out that the great military leader seemingly anticipates in imagination every possible point of attack and defense on the part of his opponent and carefully prepares in each case for a particular type of procedure. In this manner, the necessity for extended thinking on the battle field may actually be avoided. The thinking and the planning are done, perhaps, a year or ten years before the fighting actually begins. But even a great man has his limitations. He may fail to provide for such things as the weather or the unexpected stubbornness of another man. So a great battle may be decided in part by a light rain or by a psychological trait.

This type of preparation seems to be very widely used, although it is often misunderstood. Perhaps, outside their own personal lives, the most interesting illustrations for most students may be drawn from football. The general impression of many college students seems to be that considerable thinking must be done on the playing field in the midst of the rush and tumble of the game. The best captain, therefore, is the one who is both able and inclined to do his own thinking. If one may believe the coach, however, the ideal captain is one who is adequately prepared beforehand

through a careful understanding of each possible play, from "the best on down to the worst," for every possible situation, including each part of the field, as well as the tide and the stage of the game. The necessary thinking and planning are supposedly done by the coach in the quiet hours or days preceding the game. During this preparatory period, he develops his methods of attack and plans his defense and passes them on to his men. After they have thoroughly familiarized themselves with them, little additional thinking is usually required. The major task of the captain and player now concerns their ability to glance quickly over the total situation, and to bring out the most desirable play for the particular moment. This is perception and understanding, but not thinking, — at least, where the latter implies discovery through the evaluation of unlike means of securing satisfaction (or reaching some end) in terms of their relative effectiveness. The particular situation, when properly viewed under playing conditions, serves to release the right mode of attack. Another good example of functional preparation is to be found in the case of the student who always sits on the back row of every classroom he enters. Such a student is unquestionably prepared, long before he arrives at a particular classroom, to go to a particular — last — row of chairs. He may actually be disturbed if unable to go there. In this case, we find the determination of human action as a result of some past experience expressing itself in a simple, yet striking, manner.[1]

C. *The Nature of Set*

In every case of psychologically prepared action, the individual is set, we say, either quite momentarily as in the simple reaction experiment, or fairly permanently as in almost every instance of some action pattern which has been established early in life. *Physiologically speaking*, such factors as set, priming, and preparation are not *independent* agents or forces or things. What an

[1] It is wholly possible, of course, that the student sits in the back row of every class because the motive that drove him there the very first time still exists. We cannot, therefore, explain his behavior in his latest class in terms of some *habit* any more than we could explain the first time in this way. To be clear, let us assume that he has been a poor student in all his classes, and he has always sought the back row in order to get as far away from his instructor as he possibly can. His action arises as a way of escape from a relatively unpleasant situation. He cannot completely run away. The behavior in each next class is but an expression of the same old motive or desire.

organism does tends to change with time. It is inclined now one way, now another. What it has done affects what it does now and in the future. Set, then, represents in part a historical residue. Regarded in this manner, set becomes a very significant form of causation. This is saying no more, to use an analogy, than that the several possible bendings which an iron pipe may suffer necessarily affect the rate at which some fluid flows through it. Each bend is a determining factor, yet it is not something distinct and separable from the pipe.

Psychologically speaking, the matter is somewhat different. One does not observe any group of *properties* that might be peculiar to set. In the reaction experiment, for example, the individual observes that his arm is rigid and his fingers are fastened tightly upon the key; that he is ready to act; and that he definitely expects — intends — to move as quickly as he can in a certain manner when he perceives a particular environmental object. There is nothing here of an observable physiological nature. This, moreover, is all there is of a psychological nature. Physiological set, in terms of reaction, refers to some general neural condition which sustains and directs behavior patterns. It is evident that if we could observe the functioning of the nervous system, we would know more than we do about the physiological nature of set. If we knew, for instance, the answers to such questions as why human infants will accept sugar-water but reject lemon juice, or why newly born animals will observe moving objects and disregard non-moving objects, we would know more about set. As it is, however, we must depend upon our knowledge of what and how man perceives and acts — upon the nature of the functional products — for much of our understanding of set. We recognize that men definitely tend to consider certain objects and not others. When not otherwise instructed, they are more concerned with the various objects which have been closely connected with their histories. So the hunter looks at guns, the botanist at plants, the entomologist at bugs, the detective at criminals, and the psychologist at people. A commentator [1] recently complained of being puzzled and frustrated by the divergent pictures drawn of modern Russia. What one traveler reports seems to have no relation to what another writes. From reading the accounts of two persons who made the same journey at the same time, "I would have

[1] I. A. R. Wylie.

supposed," we are told, "that they were traveling in different worlds." Four distinct ways of approach to Russia appear possible. These ways are (1) as the average tourist traveling for pleasure, (2) as a communist, (3) as a capitalist, and (4) as a detached observer. To draw a clear picture, we are told, one way must be strictly followed even though it is evidently one-sided.

In connection with set, as we have previously suggested, we find a most outstanding phase of individual development. Psychologically speaking, an individual seeks, expects, or desires some particular end — he perceives and acts in certain ways because he has previously found satisfaction. So long as his fundamental motives and the environmental conditions of satisfaction remain unchanged, we normally expect an individual to show the same behavior. In general, then, an individual never *observes* that he is prejudiced or biased. If he did, we necessarily assume that there would be fewer conflicts and less dissension. Individuals perceive the objects or situations of their world but not their causes. Set is one form of cause. Causes, regardless of their nature, are relations which are understood and thought out. The lives of savages, children, and ignorant contemporaries show much perception, but little understanding or thinking. As a result, they are relatively unacquainted with causative factors.

The Significance of Set in Everyday Life. Each normal individual is definitely set to expect from others and to carry out himself certain forms of actions at the table, in the church, in the barber shop, and on the beach. He carries these various determinations for action with him to his social gatherings where, in terms of them, he evaluates the behavior of other individuals. If the latter do not act on such occasions as he ordinarily expects in terms of personal history, he is normally inclined to be censorious. Regardless of the level of his development, unfamiliar actions definitely tend to upset him. Lacking adequate preparation, he possesses no ready-made ways of meeting and dealing in a satisfactory manner with such patterns. Uniformity definitely tends under such conditions, as elsewhere in the world, to reduce friction. Conformity undoubtedly facilitates social traffic; it minimizes the chances for conflict. The psychological reason for the success of the "yes" man should be evident. Most persons do not like opposition. It impedes. For the type of individual for whom agreement with others upon all matters comes easily, success is

definitely assured in certain life situations. Fortunately, however, for the success of other men, this does not hold true in many situations. As many individuals grow older, unexpected changes in the manner of making contacts with other human beings are almost invariably distressing. Such distress is less evident in the individual who has definitely disposed or prepared himself constantly to expect new or different things. Such men, however, are rather rare. Psychological development seemingly consists to a major degree in the establishment of many functional patterns which in time become more or less fixed *in terms of satisfaction*, and within the confines of which an individual conducts his life affairs. Life necessarily *primes* every individual whether he wishes it or not. The "best" of men may become fixed in his ways. The nature of the ways determines in part both his professional achievement and his personal happiness.

D. *Habituation*

a. Its Nature. Among the several ways in which individuals become set or prepared under psychological functioning, those which are involved in habituation are rather outstanding. No habituated set is ever simple. As in every case of functioning, it involves the organism in a complex manner. It is to be regarded as being in part a functional condition whereby an individual secures satisfaction. Man behaves in a certain way under certain conditions, both inside and outside his organism. If sufficient satisfaction thereby appears, the particular way then tends to persist because of that *one* reason. The satisfaction is in no sense a chance and unrelated aspect of the total situation. On the contrary, it is actually an inseparable feature; it is a unique, emergent characteristic or property. The particular situation assumes a significant meaning — it is pleasing. Habituation represents then a persistent form or mode of securing satisfaction. The mode normally arises in each case within a particular situation; it also derives its significance from the situation. It is a way of dealing with objects. Biologically, socially, and economically speaking, these habituated modes may be quite valuable or they may be extremely detrimental to the organism. By regarding man's habituated sets in terms of their *motivational* (not behavioral) properties, an adequate explanation of his many perceptual-actional patterns may be at times obtained. Many students are

accordingly inclined to hold that habits should be placed with instincts as dynamic factors in determining human behavior. According to Gates, for example, smoking and other types of habituated activities such as reading the paper at breakfast, taking an afternoon nap, drinking a cup of tea, or playing a game of tennis are to be so regarded. He holds that these activities are not instinctive, although they are indirectly related to native tendencies and in a measure derived from them. Since we have sought in Chapters II and III to indicate in a rather general way some of these motivational characteristics, we shall disregard at this time their possible value as a form of explanation.

Although they cannot be divorced from objects, we suggest that habits be regarded as being forms of actions which issue primarily from an intra-organic condition. Certainly no *particular* stimuli are required to "arouse" a habit.[1] They are ways of life. Needs appear, and they are always attached to satisfying objects. A need without such an object would indeed be strange. Here enters the habit. Habits, then, are patterns of actions which involve the organism and some total situation. The total situation in no way stimulates habits, it merely lends *significance* and *meaning* to those actions which uniformly appear under these particular conditions. Where habituated (as well as non-habituated) patterns repeatedly appear without this *total situational significance*, abnormality if not actual insanity exists. To another individual, the behavior is strange. He may say it is meaningless, unless he regards it intelligently. We suggest, however, that it is not meaningless to the individual from whose intra-organic state such behavior issues. He finds significance for his actions even when the situations constantly change. Only the insane, as we have said, may not change. They lag behind. In fact, they are often surprisingly free from gross situational changes as they are observed by others. Psychologically speaking, they may be utterly self-sufficient; or, they may require only *one* object for their complete satisfaction.

b. Its Significance. We wish here to approach the topic of habituation, as it is related to psychological functions, from a purely descriptive angle. We desire to discuss the nature of the more outstanding changes which occur during the establishment of precise action patterns. As a result of his habituation, man is able, within limits, to achieve more satisfyingly, more dependably,

[1] There are no sense-organs of habits to be affected by stimuli.

more rapidly, and more efficiently. Under such conditions, the possible devitalizing effects of the fatigue and strain attendant upon life are considerably lessened; and the stores of human energy are economically conserved. The repetition of an experience serves to establish certain forms of action, thereby enabling the organism to proceed unhampered by minor details with the efficient execution of major tasks which demand his consideration.

The psychological development of an individual is peculiarly characterized, in part, by the formation of a great many action patterns which tend, once they have been established, to complete themselves time after time with surprisingly little variability and with great ease. As the habituation of a particular action proceeds, many *perceptual* meanings earlier observable in the original situation may gradually drop away. They exist until their irrelevancy helps to remove them. The beginner in science will see many things that the scientist does not; they are not relevant to the latter. The younger scientist may thus make discoveries where older men have failed. In this respect, the younger are less handicapped. Moreover, instead of several properties of a situation being required in order to come to some action, one or two may be enough. Experience tends here, as elsewhere, toward simplification by way of partial elimination, with a relative increase in dependence of action upon a few properties. An increase in the precision of any particular action is simultaneously accompanied, therefore, by a reduction in the total perceptual field. Habituation proceeds, above all, by disregarding some things and by observing others. While this reduction may go quite far, it does not reach zero.

c. Experimental Studies. An interesting case showing the way in which a normal adult, when placed in a situation that, psychologically speaking, is quite strange, may link his perceptions of objects to the actions shown toward them, appears in an experiment conducted by Stratton. In this case, he wore a lens over one eye of such a nature that the right and left sides of his visual field were interchanged; that is, the *light rays* from a source on his right were brought over and introduced into his eye as they would normally be if the stimulus-source were on his left. Similarity, above and below, were interchanged. Obviously in such a topsy-turvy world for which he was largely lacking in functional preparation, his old perceptual-actional patterns were of little value.

He reached in the wrong direction for desired objects and bumped at times into other objects in his attempts to avoid them. But within a week of constant habituation, under these particular conditions, he had so established new eye-hand coördinations that he could properly reach for surrounding objects — especially the *familiar* ones. Any strange object, however, gave him trouble. The establishment of these new habit patterns did not cause him, however, *to perceive his environmental objects as possessing the same spatial properties that they had before he put on the lens.* "The feeling that the field was upside down," he remarks, "remained in general throughout the experiment" (p. 616).

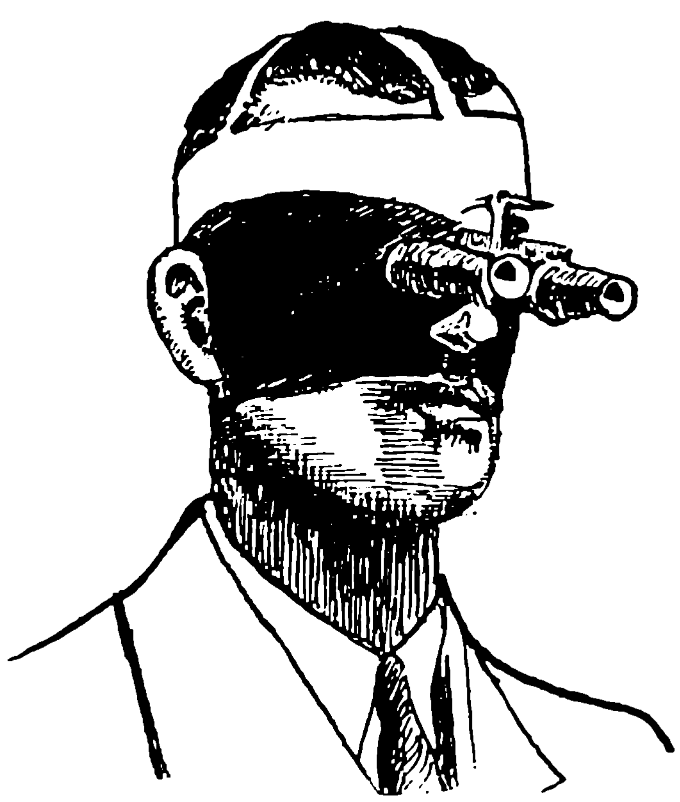

Fig. 73. Apparatus used by Ewert in studying visual functions.

Ewert has made a more elaborate study[1] of this problem of the perceptual inversion of the visual field with both eyes being used as shown in Fig. 73. Under the experimental conditions, all objects were seen as being inverted. Awnings, for example, looked like receptacles. The direction of the perceived movement of objects was also reversed. A car which approached the observer on his *right* was seen, for instance, to move from *left to right* as soon as it entered his visual field. The sound of the car, as we should expect, moved with it — from left to right — as long as it was seen. But when the car reached the edge of the visual field and disappeared, it was instantly heard at the left. In one phase of this study, the experimenter asked his subjects to sort cards rapidly into small compartments. Although they were very inaccurate at first in finding the correct box, they shortly established new action patterns, thereby becoming more efficient. They were unable, however, to reach the level attained when the perceived objects were not inverted. Ewert explains this failure in achievement as due to a *disturbance of the innate spatial characteristics of the retina* through the dislocation (inversion) of the stimulus (p. 317). Interestingly enough, however, when the glasses were finally removed, the ability of his subjects as shown in sorting cards was

[1] At Clark University with Hunter as one of the subjects.

better than it was before the glasses were put on. As a general conclusion, Ewert remarks that "the illusory visual disorientation effect did not change during a 14-day period of continuous inversion" (p. 357). During this time, however, habituation of new action patterns proceeded at a fairly rapid rate.

For the sake of his understanding, the student should realize that the results of such experiments are in principle quite like those which appear when ordinary glasses with very heavy lenses are worn. Individuals who wear such glasses must at first be very careful when moving around environmental objects or when going up and down stairways because their perceptual field is definitely changed in certain respects. The spatial properties of locality and distance are different. The individual will see objects in one place, but will tactually discover them in another place. In neither case, as we understand the matter, does a perceived object under these conditions ever become experienced as it would be in the absence of the distortion made by the glasses. In other words, the individuals who wear such glasses or lenses are never able to *correct visually* for the *physical bending of the light rays* which come from environmental sources. They do, however, establish new habit patterns in terms of these changes so that their *actions* toward their environment finally run through just as smoothly as they earlier did. They come finally to correct in action for their perceptually changed field in the same way that a man comes finally to correct for the position (distance) of a fish perceived under water until he may become a very expert spearer.

d. General Nature of Changes Which Occur. 1. *Tendency toward Automaticity.* One outstanding phase of an individual's psychological development, in so far as the establishment of any particular action pattern is concerned, appears in connection with his strong tendency to automatize such patterns. As his behavior with respect to a particular object or situation becomes increasingly habituated, it appears to require less effort and to depend less upon the environmental factors. Action is sustained more in terms of effective set. The functional level of the organism seems to be permanently changed or raised. In other words, after the perceptual reduction characteristic of habituation has been carried quite far, *any relevant property* of the total perceived situation may serve to release the action. It appears that the psychological development of an individual is characterized in part by a gradual

decrease in the degree to which his several activities depend upon extra-organic conditions. He finally comes to act effectively to slight perceptual changes (cues) — a slight change in facial expression or a slight shift in voice. To make this point clearer, we can say that observation becomes more and more determined *intra-organically*. An adult functions selectively in terms of his history. He observes objects as a result of a long personal preparation, either scientific or otherwise. This preparation involves both his needs and particular situations.

2. *Increase in Intra-organic Determination.* To the habituated individual, therefore, an apparently insignificant aspect of some total situation may release a particular form of action. This reflection in action of a change in one property is not limited to man. It appears, for example, to a striking degree in the performances of horses and dogs which have been highly trained for stage performances. The particular characteristic of a total situation which releases such behavior may be wholly imperceptible to the naïve spectator. A change in the posture of the trainer, a shift in the position of another member of the animal troupe, or an inflection in the trainer's voice may be adequate to release an action pattern. Years of training are often required in order to establish many of these "stage" patterns. Usually, persistent effort is necessary to keep them at a high functional level. The trainer makes use of every device at his command to establish and maintain these levels of animal achievement.

During habituation, either at the human or subhuman level, we discover a series of related changes in which a gradual reduction of the dependence of a perceptual-actional integration upon extra-organic conditions is simultaneously accompanied by a gradual increase in intra-organic determination. The trend in such development is toward a greater degree of internal regulation and self-sufficiency. Animal life from the lower to higher forms reveals an increasing degree of independence of purely physical phases, — for example, the temperature of the environment. For the final initiation of every habituated action, however, there must *normally* be the perception of some object or some situation. Man may be ready to act, but he must have something to respond to.

3. *Amplification of Patterns.* We have seen that repetition contributes to uniformity. After he has repeatedly functioned in a given manner toward an object in a particular situation, an

individual is definitely inclined to function subsequently in this same manner; in short, he ceases to be neutral. Because he has laid, in this way, a foundation for a particular type of behavior it may be *possible* for him to add readily to it upon later occasions. We commonly recognize that it may be relatively easy to elaborate further upon certain action patterns after they have been established. But we also recognize the possible difficulty of establishing in the very beginning desirable basic factors, that is, what some scientists call the fundamentals. If the student will pause here to consider for a moment the manner in which a dependable pattern is acquired in playing musical instruments, or in tennis, boxing, juggling, or writing, he will perhaps understand what is meant by the term "amplification."

When attempting to develop skill, an individual starts with a very simple perceptual-actional pattern. After this has been partially integrated, he gradually extends the pattern, bit by bit, to include in it other — new — items. In playing the piano, for example, an individual may begin with three or four simple basic movements and bind them together into a unit. In fencing, he may practice for some little time upon a single pattern such as forward-thrust and a backward-step. In tennis, he may drill day after day upon a particular, desirable form of stroke which may involve a given bodily posture, a definite position of the arm, and a certain turn of the wrist. In each case, after he has achieved both control and uniformity, — in short, after a pattern has been partially habituated — he proceeds to incorporate new and related phases. He does not drop the previous pattern. He merely adds to it. For example, instead of having a three-phase integration, he may now have a five-sequence integration.

In amplification we see one outstanding direction in which psychological development under habituation proceeds. Functionally regarded, an individual starts quite simply, and slowly spreads out to include more. He develops by extension — not in a physical sense like a creeping vine. He grows by adding here and there to that with which he has already started. A very common barrier to a larger and more effective development probably lies in the individual's failure to establish originally the kinds of patterns most conducive to his later development. Where there has been wise instruction and proper guidance in the early stages, the fundamental items necessary for broad development are

usually so firmly laid down that the possibilities for future enrichment through the addition of new and different features are greatly enhanced. Since this matter of habituation is primarily concerned with acquisition of dependable, efficient patterns, we must assume that the outstanding differences to be found among individuals, of different degrees of the habituated achievements, must be normally referred both to the original character of the basic patterns and to the particular manner in which they were established. We recognize, of course, that an individual, like a great city, apparently grows as a direct result of the incorporation of the new with the old. That which goes on during the earlier history of the individual may have far-reaching effects in subsequently determining the ease with which he is able to extend his adult behavior patterns.

4. *Simplification.* Man's development through habituation is also characterized by simplification. There are literally thousands of such illustrations to be found in the daily life of each individual. He can discover this sort of psychological change, for instance, in each form of his *skillful* patterns. It is, indeed, a very important way in which progressive development occurs. It simply means that as habituation continues, thereby lifting an individual toward a higher level of efficiency or of achievement, many random and unnecessary movements which were incorporated in his action patterns at an earlier period are gradually eliminated.

In a great many cases, an individual's activities may be so cluttered up with these useless forms that he cannot successfully compete with others. It is a significant truth, moreover, that he may *have no knowledge whatsoever about the existence* of this excess baggage. He may know no more about it than he knows that he supports many tons of air. This is particularly true in all those cases where an individual may have been carrying this load from his very early *pre-critical* days. An individual is introduced by birth into a particular cultural group. The language of the group becomes his language. He certainly does not evaluate it during his earlier years. Should he later, upon finding it inadequate, seek to change it, he may suffer much social opposition and conflict. So long as he remains closely bound to his group, he may never know its (his) inadequacies nor seek to change himself. The importance of this fact is recognized in all cases where a heavy premium is laid on excellence. A boxer who is unaware of his

unnecessary burden does not realize, for instance, that he invariably telegraphs his big punches to his observant opponent before he actually delivers them to him. It is not surprising, therefore, to find some individuals achieving in a mediocre manner while others achieve greatly, although there may be no inherent reason for the significant difference. The successful gambler or the very suave politician must necessarily have dropped all those telltale facial properties which characterize the novice or the unsophisticated. A university lecturer, too, may have no knowledge of the "ahs" and the "ers" with which he generously intersperses his sentences. If he did, we assume that he would endeavor to drop them. The skilled artisan, also, may use many extra random movements. Upon their elimination, his efficiency may be greatly increased. By means of the motion picture camera or through a very efficient observer, an individual may quickly discover such useless items in his patterns; and he may be materially assisted in attempts to improve himself and to economize his time and energy. In this connection, we point out that good coaching and efficient industrial management have long since recognized and taken advantage of the possibilities of rendering an unusual service to ambitious individuals whose effective progress may be seriously impeded by the unnecessary burden of eliminable items which they carry as a form of youthful contribution.

5. *Unification.* In addition to the above ways in which man's psychological activities are affected during the course of habituation, there is unification. Not only may new items be added to enrich his patterns and old ones be dropped to simplify his patterns, but those items which finally remain to constitute the pattern are gradually tied more closely together just as two casual acquaintances may come with time to be bound, psychologically speaking, very closely together. As a major result of this psychological integration, the habituated actions which at an earlier time might possibly have been easily disrupted by some momentary condition, either extra-organic or intra-organic, come at last to run their courses despite tremendous odds or distractions. Action patterns, such as we have enumerated above, in which an individual at first may fumble, stumble, and stutter, come finally to run smoothly to their end.

The dependable accuracy of the football player who receives the pass, the intricate fingering movements of the virtuoso, and the

easy fluency of the fine speaker all seem, at the end, to be so easily done. Back of each of these, in the usual case, necessarily stand periods of rigorous drill in which the whole pattern is welded tightly and smoothly together into a continuous, unbroken whole. This integration, though psychological, is quite comparable with the joining together of steel plates into one piece by the electric torch. In these psychological integrations, however, the conditions involved in constant repetition under the compulsion of some strong, insistent need are the real workmen at the joints.

6. *Structuration.* Finally, the observant student will undoubtedly discover in his examination of many habituated patterns that all parts do not possess the same significance or show the same degree of prominence. Certain items apparently dominate other items; that is, particular features stand out more prominently than do others. They are, we say, more structured. The integrated whole or pattern is unquestionably continuous, yet it is not level. For better understanding, we may compare it with the high and the low areas of a rolling country. There is undoubtedly complete continuity in this case, yet there are elevations which command, or stand out above the surrounding region.

In every case of acquisition, for example, some features are more meaningful than others. Certain parts seem to offer greater resistance to integration than do others. Where a few items stand out clearly from the others, the integration of the total pattern seems to begin around these and to extend finally to include the remaining items. A simple analogy may be drawn in terms of the spaced emphasis introduced by the drum into an orchestra. It apparently assists in binding the various objects more closely together. In the usual case, again, the rhythmical grouping of the various objects or movements of a habituated pattern tends to introduce organization. Children seemingly learn with greater ease when the materials are rhythmical. The rhyming words in a poem tend to dominate the whole pattern. The occurrence of two like sounding words at the ends of the two sentences or units apparently contributes materially to the establishment of the whole pattern, including the materials which precede and follow them. Practice, according to Koffka, materially assists an individual in the formation or establishment of some figure (figure-ground relation). Perhaps the student will be helped here, if he will understand that a few items among the many possible in a

total pattern are more figured than others. With this understanding of the more salient features of habituation, we can briefly regard such patterns from a slightly different angle, *namely*, in terms of their relations to each other and to the non-habituated activities.

E. *Three Types of Habit Patterns*

a. Contributory. A habituated pattern may run on to assist the organism in the conduct of some non-habituated activity. It is a truism, Herrick remarks in part, that our elementary education seemingly consists largely in the acquisition of correct habits. That is, much of what is painfully learned by concentrated effort must become so automatized that it no longer requires the undivided efforts of the individual. In this way, he is free to concern himself with more significant matters while the acquired neuromotor patterns are at work with the petty administrative details. The post-office clerk, for instance, automatically shuffles the letters, and boxes them properly, but he is keenly observant of the names on the letters. Lacking this highly habituated pattern, his work would be far less efficient. The student in his many forms of work and play is greatly aided by his habituated patterns. In a close game, he can use his energies more effectively in his attempts to outwit his opponent if he is not required to observe closely other features of the game. He cannot easily consider both at the same time. We recognize, moreover, the extent to which an individual may be aided in his more serious thinking by the use of the figures and words which he puts down on paper without any thought being given to the particular manner in which it is done. But his thinking, however, is not habituated.

b. Dissociated Patterns. Two or more habituated patterns may undoubtedly run their courses simultaneously, yet be independent of each other. The industrial worker, for example, may operate one part of his machine with one hand and another part with the other hand if his task has demanded that such patterns be established. He can drop one pattern without impairing the efficiency of the other. He cannot, however, change from a one-pattern to a two-pattern without at first impairing the efficiency of the one-pattern. The ability to carry out simultaneously two or more action patterns actually implies a normal form of dissociation. That is to say, such patterns have only one feature in common,

namely, there is but a single individual. Perhaps a striking illustration for most students is the juggler, who may make a ladder walk around the gymnasium, while at the same time he keeps several rubber balls moving in the air. If he wishes he can do *each* singly because each is independent.

c. **Single Independent Pattern.** Finally, a single habit may run its course and apparently for a time dominate the energy patterns of the organism. A great many cases of this sort may be found in the daily life of a normal individual. One thing is done and when it is finished the individual turns his energies in another direction.

F. *Hypnosis*

Some interesting information upon the subtle determination of the psychological functions has been obtained through the experimental use of hypnosis. If an individual is psychologically prepared under hypnosis for a particular action to be carried out later, the action usually tends to complete itself when the appropriate situation appears during the period following hypnosis when the individual is no longer hypnotized. There is, of course, no training or repetition in such cases. There is, perhaps, merely the brief instruction of the operator to the subject that upon the perception of an object or of a movement such as may be involved in the experimenter's looking at his watch, he will look around him, or think about a certain object, or carry out a certain action. Under such preparation, each time the experimenter removes his watch from his pocket, as if to learn the time, the subject, may, for instance, rub his left hand with his right hand, or observe that he thinks about doing this. If questioned, he may report that he does not know why he functions in this particular manner. Or, he may rationalize his actions in a way which is more or less satisfactory to himself. The functional determination in this, as in other similar cases, may immediately disappear as soon as the experimenter explains the nature of the preparation. His understanding of the causal conditions in such cases actually assists the individual in controlling his actions. This is also true, of course, in a great many cases in the ordinary affairs of life.

The most illuminating aspect of such post-hypnotic behavior appears to lie in its immediate determination. The individual is definitely prepared through the employment of a purely psycho-

logical method to carry out some action upon a later particular occasion. When the appropriate object or situation, indicated in the instruction, is perceived, the action tends directly to follow. There is a precise determination in every case, but there may be no accompanying knowledge by the individual of the antecedent conditions. In this simple manner, a perfectly normal but hypnotized *adult*, who is properly prepared through instruction, may be made to show patterns which in certain respects are quite like those to be found in a normal child; the *determination* is similar. In the child, as we have said, very precise forms of preparation for later functioning may be established in many ways. The developing individual then proceeds, perhaps in a short time, to forget the occasion under which the priming or setting originally took place. Yet later, often after many years have elapsed, the previously prepared individual may possibly experience a strong impulsion to act in a certain manner toward a certain object or class of objects. It may actually carry out this action. When reasoning and emotions are normal, it successfully resists such impulses. When such impulses are so strong, however, as to lead to actions which are socially or legally undesirable, students commonly regard such as being abnormal.

From hypnosis, from childhood, and from abnormal adults, then, a great deal of illuminating material upon action patterns and their determination may be secured. Such materials show, among other things, that where there has been a certain type of preparation, various action patterns may possibly run their courses without any knowledge of causation and possibly without any intelligent guidance by the individual. In all such cases, the normal and the abnormal clearly overlap. What holds for the one, applies similarly to the other. It appears to be the nature of the human organism that it must act directly in many cases in the absence of any understanding of immediate causes. Both racially and individually considered, man is apparently impulsive long before he is rational. Individuals may possibly develop the latter forms of behavior, but they are certain to show the former sort.

G. *Purposeful Action*

a. The Inadequacy of a Purely Materialistic Approach. At this point we turn our faces in a direction that the very strict mechan-

istic and materialistic student apparently shuns.[1] We are forced, however, to take this non-mechanistic, non-materialistic path for the simple reason (among others) that purpose, as we regard it, is a major determining factor in life. It is quite impossible, we suggest, to understand scientifically the more significant activities of man without considering the significant part which purpose plays. Moreover, no one has ever scientifically reduced a purpose to a materialistic level, that is, to tensions in the throat, to changes in respiration, to general bodily postures, to unobserved muscular and glandular responses, or to unconscious reflexes — in other words, to strictly physical and chemical levels. Nor, for that matter, has any one ever reduced any other *psychological* phenomenon to such descriptive levels, despite the fact that the student may occasionally be led to believe that such reductions have been made. In purpose, we discover a *goal meaning* serving to determine an individual's actions. Purposive activity goes forward under the light of an end or ideal to be attained. This particular way of determining behavior cannot possibly be ignored without disregarding some of the most significant forms of human actions as far as scientific and social progress is concerned. A large share of human behavior, Woodworth points out, is directed toward definite ends. Some actions are formulated beforehand in words; some, in imagination; some, in drawing and designs; and some, he says, in patterns and models.

b. Habituated Patterns Represent One Form of Purposive Action. Every normal habit pattern is purposive. It is, by its very nature, directed toward the accomplishment of a particular end. Even where it merely assists non-habituated activities, it is purposive. In every case, the history of the pattern partially reveals its nature. It appears as an established way of serving an end. It is a prepared form of acting under specific conditions. It is understandable, then, why some habituated pattern may lose meaning (satisfaction) when the use, for which it was originally intended, disappears. That is, when the particular conditions under which it was established change, the pattern normally tends to lose its original significance. If it should now persist in its old form it may cause the individual no little

[1] For an illuminating discussion of the inadequacy of a materialistic approach to psychology, the student is referred to the *Brains of Rats and Men* by an outstanding neurologist (Herrick).

trouble and unhappiness. We are all familiar with the story of the old farmer who drove his first car up to the country store and, wishing to stop, shouted "Whoa." To avoid such dissatisfaction the individual normally changes as the situation changes. But at times some way of functioning is productive of so much satisfaction that an individual does not change — there is no cause for change. In extreme cases, this persistence of a pattern of satisfaction may furnish symptoms of an abnormal personality. A particular habit pattern, then, *normally* appears within a *particular environmental situation.* When an action pattern appears without its appropriate situation, it accordingly lacks significance for another person who may be observing it. If a mechanic, for instance, wishes to remove the wheels of each car on the street, if a retired minister persists in preparing and delivering sermons to an empty church, or if a painter plies his trade on each house or object met along the street, the pattern may be abnormal. If we are quite unable to discover anything in the total situation — the time of the year or a gala period — to account, for instance, for actions of the painter, we hold the man to be abnormal.

Such patterns are necessarily somewhat stereotyped and particularized. Although they are extremely valuable in their way, their way is undoubtedly too narrow to bear the more important traffic of human affairs. The student should understand, therefore, that as long as he confines himself strictly to the descriptive level of habits and their formation and changes, he will be unable to penetrate very far beneath the surface of many major life problems. Normal man does not always live at the level of habit. Man may, in fact, cease overnight to satisfy a habituated need of many years' standing. The old need — desire — may or may not be present. The new satisfaction may possibly emerge so strongly that the old is no longer present. We do recognize, irrespective of theory, that men may suddenly become converted "from bachelorhood and from sin." The new emotional excitement attendant upon these striking changes may extend to and definitely affect many of man's long-established habit patterns. We invoke no magic. The way here is quite analogous to that found in the case of some normally cautious man (banker) who in a moment of strong emotion (wonder, greed, fear) may wholly ignore those basic rules and precepts which have long guided him.

When man falls in love and then discovers that his former sat-

isfactory patterns definitely conflict with the satisfaction to be derived from the new love situation, the former may be immediately dropped. Some measure of the degree of a man's love may possibly be secured in terms of the extent to which certain former patterns are observably affected. It may at least serve as one criterion. Daily life is seemingly filled with reproaches and laments of this general tenor: If you really love me, you will give it up. Kipling has drawn a poetic picture of the resolution of a struggle between the love of a man for a woman and his need for nicotine.

> "Maggie has written a letter to give me my choice between
> The wee little whimpering Love and the great God Nick o'Teen.
> And I have been servant of love for barely a twelvemonth clear
> But I have been Priest of Partagas for a matter of seven year.
> So light me another Cuba; I hold to my first sworn vows.
> If Maggie will have no rival, I'll have no Maggie for spouse."

We are reminded here of a pertinent remark by Herrick concerning the peculiar life significance of habits. The educational process, he points out, which is arrested at the stage of habit formation — it matters not how extensive the repertory and how perfect the mastery of the letter of the lesson assigned — is *scarcely begun;* it is a failure. True education, he holds, must use the knowledge and the skill thus acquired merely as the necessary tools for constructing out of the experiences of life new and individual methods of response, larger powers of logical analysis, critical appreciation, and personal ideals.

c. Some Characteristics of Purposive Action. Purposive action shows certain outstanding characteristics which seem to distinguish it from non-purposive and random forms. In purposive behavior there is usually a rigorous selection from among a number of environmental objects of those particular few which satisfy the needs and direct the activities of an individual. In writing a theme, for instance, the student refers only to those particular objects (properties) which appear to him to be relevant to his descriptive problem. Since purposeful activity is definitely directed toward the attainment of some particular end, there is precision of procedure. Random behavior disappears as purpose appears; it becomes decisive. Purpose is an orderly touchstone. We accordingly say that we know where another individual is going, or that he is hurrying because he aims to reach a certain place. Purpose, for example, accounts for the difference between

merely traveling and going some place. Lacking a precise environmental goal to sustain him, the individual who is lost may wander in a circle.

Furthermore, the final execution of a purposive action may be greatly delayed; there is no immediate satisfaction. It is not that sort of situation. The satisfaction that accompanies anticipation or some other form of imagination is sufficient to sustain the individual. In many cases, the delay that is to be found before goal-satisfaction emerges may extend over a period of years. Each student who aims at passing a medical or a bar examination must at times recognize quite keenly how far into the future this delay may possibly reach. This is, indeed, a most outstanding characteristic of purposive behavior. The substitution of one form of satisfaction for another represents no mean ability. In fact, man places a heavy premium upon it. It is not at all strange that an unflagging persistence extending over a long period of years and often in the face of great odds should merit recognition by other men. This particular aspect of purpose, we suggest, is a unique human property. No kind of subhuman has ever shown patterns with such long postponed datings upon them — datings which are much like the ordinary instruction "Not to be opened until Christmas." As a direct result of this one characteristic, man undoubtedly shows many significant and progressive achievements. Human beings build and create as stepping stones to achieve a remote end. When there is nothing ahead, man moves aimlessly here and there or stops. Eastman, the kodak manufacturer, is reported to have committed suicide because there was nothing of a creative nature ahead of him to sustain him — to keep him moving. The ordinary individual may possibly deny himself certain forms of pleasures over a period of years in order that he may finally enjoy a few months of vacation during which he is able, perhaps, to do a few things he has long wished to do.

Some forms of purposive action also show a great degree of flexibility and novelty. New ways of reaching some end may appear suddenly. It is accordingly impossible to show that every purposive pattern has a long history — a long training period. In the same manner, to cite an analogous case, an intense fear may very *suddenly* appear where no fear previously existed. Let us note here that a habituated pattern, for example, normally tends to run an untroubled course. When it is disrupted by the

introduction of some new factor, for example, when some form of satisfaction which has repeatedly been secured in a situation is no longer possible, the organism often tends to be baffled and upset. Since the satisfaction has become specialized, that is, since it is a property of a particular object or situation, time is normally required for a shift to another satisfying object. Some time and trouble may be required in order to discover another object which possesses the same property. A certain food, drink, hat, mashie, chair, or friend has been satisfactory. When one now becomes absent or lost, it is often difficult to find an adequate substitute. Sometimes, quick shifts in habituated patterns are not easy. An animal, if forced, may very quickly change its way of getting to some kind of food. But if a satisfying form of food is denied it, the animal may actually approach starvation before it will finally accept another form. Again, we recognize that a member of some animal species will apparently remain unmated during its life after being deprived of its original mate which chance (nature) gave it. In non-habituated behavior, however, when an obstacle (thwarting object) is met the individual pushes ahead, increases if necessary his expenditure of energy, and modifies constantly his mode of action — his persistent seeking — until a particular goal is reached, or until a new and different one is established.

The student should understand that purpose cannot be separated from object or situation. It is, in short, a meaningful aspect of a life situation that appears as a result of instruction or preparation by other human beings or by some situation. A mother, for instance, may instruct her son to live so that when he becomes a man he will possess characteristics or properties like those of his father. The desire and the intention to become a man possessed of such properties may guide and sustain the boy over the developing period of his life. Such characteristics may possibly serve at times as a measuring rod of the rate and the extent of development. Again, some particular situation may similarly instruct an individual. For instance, a student walks into a classroom and glances over the chairs there. He normally perceives a chair by the window or near the door, in the front row or at the back, as being one to be taken when the class assembles. He may select a particular chair then because it satisfies his purpose: To get near the window or to sit as far as possible from his instructor. Again, men may be permanently changed by the sight of the horror and

suffering of a poverty-stricken group. As a resultant of this change, they work at modifying such conditions until they create a satisfactory situation. The individual may also instruct himself in accordance with a purpose. Verbalized, such instruction might run thus: It is my purpose to train myself so that upon graduating I shall be a fine physician; or, I intend to change the laws of the land in order that a condition of equality for all men shall prevail; or, I purpose to work hard so that I shall be warmly clothed, properly fed, and adequately sheltered in my old age.

Purposes come through different functions. One simple form of purpose appears to arise directly through perception. Many activities of animals and little children are largely or wholly limited to this general class. Any situation that satisfies an animal cannot remain neutral. The hungry organism furnishes much evidence on this point. Thus, in addition possibly to its color, size, or shape, a situation may also have the property of hunger satisfaction. Animal and man see and hear many things and move toward them because they offer satisfaction. Again, the dog or the cat that goes after its young and brings it back is simply maintaining a perceptual situation that satisfies it. We do not raise the question of what the animal intends or thinks. In fact, certain actions of rescue of one man by another may appear so quickly that even an intelligent man would lack time to think. These ways of dealing with objects which repeatedly end in the form of a *quiet, non-restless* situation or of a playful situation are to be considered as being purposeful. Men also create various situations through imagination and thinking. In each, he may be set or inclined for purposeful action. Thus an object of imagination becomes desirable to him, and he orders his actions to achieve satisfaction. He may change — add to, subtract from, or rearrange — various environmental objects in order to reach some one particular situation. He functions at this particular moment because it satisfies him to consider the pleasure which is to come in the near future or after many years.

The ambitious student who has been forced away from school by sickness readily understands the nature of situational instruction. He may repeatedly say, "I must get back if I am to go on with my career. I must not stay away. I must be preparing myself." When he has returned to school, however, he may go for fairly long periods without thinking about the particular purpose which holds

him and lends significance to his labors. The total situation actually carries him through his classrooms and keeps him at his studies. Some purpose brings him to school. Once there, the total institutional situation may then sustain him. He may draw upon his major objective only at critical moments when a disrupting condition exists.

d. Significance of Purpose. The history of man is filled with stirring accounts of great achievements and unstinted sacrifices made in the light of strong purposes and ideals. Habit sheds very dim light upon them. A Cromwell, for example, does not develop a habit of beheading a tyrannical ruler. Nor does a Moore develop a habit of placing his hand upon the flame instead of his name upon a piece of paper. Those individuals who have suffered the agony of the stake or the rack in support of their ideals have not demonstrably done so either habitually or reflexly. The countless men and women who have struggled and died in their various attempts to improve social, economic, political, and educational conditions in order that those who were to follow them might enjoy a fuller life cannot be said to have been primarily activated by habit.[1]

We must recognize, then, that men act in terms of purpose; that they often exercise choice; that they evaluate different actions in terms of some possible form of satisfaction toward which they may struggle for many years; that they show much ingenuity in surmounting barriers in their course; that a purpose serves as an important way of determining action; and, finally, that men differ in the degree of tenacity with which they may hold to a determination — intention — in the face of odds. We wish to examine briefly some of these points.

Man would probably be much happier than he now seems to be if his life situations were always so simple that his habituated types of actions were adequate in bringing satisfaction. That man deliberately seeks to order a great deal of his behavior in this relatively simple manner accounts, no doubt, for so much of his habituation. It accounts, at the same time, we suggest, for his very wide use of precise rules and regulations. Rules, when strictly adhered to, tend mainly to simplify many life situations. Great men have, at times, explained their achievements in terms of their strict observance of set rules. Franklin and Washington,

[1] Unless the term is extended to include everything man does, in which event it becomes quite valueless for descriptive and distinctive uses.

as every school child is repeatedly informed, laid down very early in their lives a set of rules to follow. In our opinion, however, they were, like many men, much too big for any set of rules. We doubt if any man can ever achieve above mediocrity by adhering closely to rules. He may possibly be happy, but he will never be outstanding. When applied to moral and ethical affairs, rules may actually assist many individuals in ordering their behavior along approved lines. Close adherence to many rules implies a lack of understanding or an evident reluctance to face issues and settle them intelligently.

e. The Relation of Rules and Advice to Purposeful Action. Behavior by rule is precisely predetermined. If a rule is sensible or if it is closely followed, little confusion usually occurs. An illustration common to everyone makes this clear. The rule of the road is to turn to the right upon meeting. This rule definitely organizes and clarifies traffic. The momentary confusion and trouble that result when this is not followed may be seen in some chance meeting between two individuals upon the sidewalk. Each may swing alternately to the left and the right without advancing, to the possible annoyance of both, until one individual thrusts ahead (obeys or disregards the rule) and settles the matter. If the student will recall the childish confusion in certain groups in Washington during a recent administration over the question as to who should precede whom at certain social functions, he will no doubt realize the distinct value to be derived by holding strictly, whenever possible, to established rules in all situations where intelligent understanding is either lacking or undesirable.

Where conditions change and stagnation is undesirable, the best of rules must necessarily fail. The wise individual is one who knows when to break his long-cherished rules and how to avoid the usually keen discomfort which such action commonly entails. The extremely conscientious individual who has broken a rule may suffer exquisite agony. On the one hand, he may have the exhilarating feeling of elation that so often accompanies the breaking of restraints and the exercise of his manly prerogatives; but on the other hand, he is not likely to escape the silent, although strong disapproval of his firmly established attitudes concerning such matters. He may smile, at the moment, with pleasure at the one; but tremble, at the next moment, with fear of the other. Moreover, many individuals who are unable to come to any action

concerning a particular task or problem often seek counsel and guidance from others. The advice which they receive, although often unwise, usually tends when implicitly followed to relieve them; it at least frees them from the necessity of making their own selection or choice of actions. Most of us admire the individual who is able to resolve some ambiguous situation and point the way to be followed. We recall the confidence that came with the decisive attack of President Roosevelt upon the problems of the depression.

H. *Choice Action*

a. Its Nature. Choice action always arises in a situation in which there is an "either — or" meaning. The situation confronting an individual is ambiguous; and his actions show it. There is accordingly no single way that leads directly and immediately to satisfaction. In every case, the individual either entertains two different goals or faces two unlike ways to a single goal. Moreover, the acceptance of one of these must necessarily entail the rejection of the other. The individual understands that he cannot "have his cake and eat it." If he could, there would be no choice problem. Such two-sided situations often confront the individual. They apparently involve every type of relationship — religious, economic, social, industrial, political, recreational, educational, ethical, and scientific.

Specifically expressed, the "either — or" situation may be expressed in this manner: "How shall I find the truth — through science or through religion? Shall I marry for money or for love? Shall I go into medicine or into law? Shall I accept or refuse this invitation? Shall I increase my plant, or hold it as it is? Shall I interpret my scientific data in this or in that way?" From each of such situations one illuminating actional fact stands out very clearly. The individual is quite unable to *do anything* — get under way — until the two faces have been reduced to one. He cannot possibly act until the divided determination has been replaced, perhaps, by some one determination, intention, or instruction of this sort: "I shall proceed in this way. Or, I wish or intend to take this one." When this meaning appears, action may instantly follow; and the individual may be under way without further delay.

b. Significance of Choice. This particular type of activity may be very costly when measured in terms of frustrated accomplish-

ment, time, energy, and money; or, of friends, respect, happiness, and morale. In fact, the unhappiness and the worry which are commonly attendant upon an alternative which has been forced upon an individual — and the student will realize that such are usually not of the normal individual's seeking — may occasionally produce serious consequences in certain types of personality. The struggle and the strife which may accompany the making of some decision, or settling a choice, may contribute to the development of a neurotic condition. They may tear asunder an individual's psychological integrations. Perhaps every individual has observed the pleasure and relief that commonly come with the settlement of a prolonged state of indecision. Every normal person must necessarily have suffered, at least to a minor degree, from the temporary upset that precedes the selection of one of two possible ways of forging ahead toward the realization of a form of satisfaction.

c. Determination Is Always Necessary. As we have previously remarked, we assume that every psychological phenomenon (every functional event) must have some cause. In these striking cases of indecision, there is a very definite cause. It is simply this: There is no specific meaningful determination to release and sustain a particular action pattern. It is unnecessary to maintain that the vacillating individual *can* act, but will *not*. On the contrary, the individual *cannot* act; he cannot proceed; he is momentarily helpless because no adequate preparation for functioning has been previously established. These interferences in behavior are very instructive, psychologically speaking, because they present an aspect of action utterly different from those forms in which an individual functions smoothly and uninterruptedly. Yet both forms are intimately related. The one gives an understanding of the other.

Lest the student fail to understand the peculiar significance of choice, we point out that many of the important moments of life concern such matters. The love triangle is but one striking illustration of this sort. An individual may struggle desperately to resolve such a situation, but be wholly incapable of reaching a solution. Moreover, many plays and novels are built upon this foundation: The resolution of a choice. Every student recognizes the long desperate struggle which almost wrecked Hamlet and which is epitomized in his soliloquy: *To be or not to be.* Robert E. Lee, who had long served his country both as a leader in battle

and as head of West Point, wrote upon tendering his resignation at the outbreak of the Civil War that it "would have been presented at once had it not been for the great struggle it has cost me to separate myself from a service to which I have dedicated the best years of my life and all the ability that I possessed."

d. Some General Characteristics. Properly regarded, choice action always involves a definite *task*, that is, there is something to be done — an end to be arrived at — following a period of *indecision* during which *deliberation* takes place. Choice action *delays* because it is not precisely determined by the form of meaningful situation under which an individual labors. The individual simply cannot say: Do this one thing. There is no choice, therefore, in the simple reaction experiment although there may be two keys (one for each hand) and two "possible" actions. Such action is definitely purposive; but, psychologically speaking, there is no choice. The subject is precisely *instructed* by the experimenter in the very beginning to respond with the one hand to one property of the situation and with the other hand to a different property. There are, therefore, *two* instructions. There usually is a slight slowing up of the time required to act under these conditions because the total perceptual field is slightly enlarged; there are, for instance, two or more lamps to be considered. Moreover, the determination for function is two-sided. Here, then, is an "either-or" situation — "move either the left hand or the right hand" — in which *no* choice whatsoever is possible as long as the individual understands and follows the instructions.

e. Choice Means Evaluation. Choice action must be understood to depend mainly upon the understanding and the imagination of the individual whereby he is enabled to weigh the possibilities of two unlike actions in terms of their relative degree of satisfaction. It definitely implies the evaluation of rewards and penalties, or the consequences presumably contingent upon the acceptance of *one* and the rejection of *another* form of action. It usually involves the realization, at the present time, of the probable differences in satisfaction at a future time. We often assume that a criminal individual intelligently weighs the good against the bad and chooses the latter. As a matter of fact, however, the vast majority of criminals actually develop from delinquent boys and girls who are psychologically incapable of serious evaluation. Undesirable patterns develop just as desirable (religious) patterns do: The

priest and the honest business man, for instance, do not repeatedly *choose* to do right.

Choice, as we use the term, must not be understood as implying either *no* action or *some* action. In every case, something is unquestionably going to be done in some manner. The individual is to act. During the process of choosing the organism is actually preparing itself. That is, the individual is tentatively considering, for example, in imagination, first the one and then the other way in terms of their significance. When the period of indecision ends, the individual is already on his way toward the execution of some intended action that was a part of the meaningful preparation, *namely*, "I shall either act this way or that way." Whenever two possible ways of reaching a desired end offer identical *returns* and make similar *demands* upon the normal individual in terms of his time, energy, money, honor, suffering, and the like, there can be no choice. The one way under these conditions is either as satisfactory or as unsatisfactory as the other. It is in this way that individuals often settle their indecision. "It makes no difference," they may say, "the way and the end are alike." The end, some argue, may be the same (death); but the way may be difficult. A condemned soldier may choose the firing squad in preference to the hangman. But in this case, we suggest, the end is not the same. The one may be honorable, while the other may not.

f. An Illustration of Choosing. Let us briefly consider a simple illustration in order to show how the *conflict of indecision* and the *period of deliberation* may be ended. A normal individual, for instance, may face a situation in which a choice must be made between a large car and a small car before he can buy. He carefully examines each car. He attempts to understand each in terms of its dependability, its initial price, its up-keep, its depreciation costs, and its riding properties. He considers, moreover, the prestige, the pride and the preferment which may possibly be derived through the ownership of the larger car. But he may also review in imagination, as many have allegedly done during the present depression, the disapproval, the envy, and the antagonism which may possibly arise because he owns a "luxury," when so many are in need of necessities.

For choice to exist in this particular case, such values (properties) as these must be deliberately reviewed by the individual. At last, let us assume, one of these suddenly ends the indecision and the

deliberation, and leads directly to solution and action (acceptance and rejection). In this event the individual may, for example, secure "reliable" information about possible maintenance cost; or, he may overhear a threatening remark concerning the vulgar display of wealth; or, he may figure out that the depression has finally "turned the corner." In any case, his decision is definitely made. He can now go ahead. Clever salesmen have pointed out that it is "bad psychology" to present two things (alternatives) to certain kinds of customers, for they may end by buying nothing. No resolution can be reached. They cannot "make up their minds." It is better, it seems, to try wholeheartedly to sell one thing; that is, to hold the purchaser to the consideration of one thing.

Choice accordingly involves a problem to be solved by doing something. There is a necessary period of conflict and indecision, because the individual must go through a stage of incubation during which he evaluates, in his own way, the alternative degrees of satisfaction. *The actual quest in every case is for a meaningful determination.* A basis for further action is definitely sought. This whole period is usually characterized, psychologically speaking, by varying degrees of restlessness, discomfort, impatience, dissatisfaction, worry, sleeplessness, and impotence. Under these conditions, the individual often reminds one of a racing animal that lunges and pulls at the restraining hand in his endeavors to get into action. The form of restraint, of course, is quite different. It is psychological in man and physical in the animal. We do not say, of course, that the horse "chooses" not to run.

The psychological functions involved in the usual case of choice in addition to perception and action may be understanding, emotion, imagination, memory, and thinking. Many accessory actions may possibly enter at times into the search for the information or other conditions necessary to the resolution of the choice situation. As long as the individual holds strictly to the original "either — or" situation, he must accept (reject) one object when the solution is finally reached. If his meaningful determination, however, should possibly be modified during the period of incubation to include some new action, one or both of the former alternatives may be rejected.

Generally speaking, the resolution of a choice situation is immediately followed by a particular action being initiated or carried out. But it may, however, take the form of a long-time determina-

tion, such as we referred to a short time ago, in which there is the instruction or intention to do something in the relatively distant future. An individual may decide, for instance, during the winter to spend the following summer in the North Country rather than in Europe. The determination is definitely *dated.* Nothing may be done until summer comes. At this time, no new alternative having arisen, the individual puts his determination into effect. Again, every orthodox Mohammedan plans *at some* time to go to Mecca. He may order his activities over a period of years so as to carry out his determination. Old age may finally find him on his way. The determination, in this case, carries a *dating* different from the first illustration. The student understands from his own life that his determinations are normally dated — some definitely and some indefinitely. The dating is itself a very significant aspect. When the time expires, action tends to follow.

According to Bentley, the deferred determinations are among the greatest achievements of the human organism. They may lie dormant while other actions run their course and emerge only when the appropriate setting finally appears. Such determinations often appear in the post-hypnotic period. Their peculiarity there lies in the inability of the individual to remember the original conditions of choice. In normal waking life such forgetting is rather frequent. Here it is hidden by a process of rationalization which provides an explanation for what is done. Such deferred determinations may also express themselves in the form of an intention to go back after a lifetime to the scenes of childhood. Not infrequently, however, the glamour that nostalgia and memory usually throw over these historically remote places is shortly dissipated. A former president of the United States was reported a few years ago to have remarked upon revisiting the old swimming hole which he had not seen since his youth that it seemed to be much smaller than it was when he was a boy.

I. *Will*

a. General Characteristics. Out of an understanding of the nature of action and its determination comes light upon the problem of will. Will, psychologically speaking, is essentially an intention or determination to act which persists in the face of difficulties. It should accordingly be evident that willed action is not essentially different from ordinary voluntary action, except that there is

unusual persistence in the former. However, since this persistence can only arise, that is, be known, as a result of opposition and struggle, the determination in cases of will almost invariably assumes a strong *personal* aspect. The individual understands, of course, that he faces barriers. But he is determined that he *will* surmount them. Will, then, feeds upon opposition. It is a descriptive term applied to persistent goal-seeking; it implies a refusal to abandon a task which has been undertaken. The ordinary voluntary actions of an individual, however, are usually taken as a matter of course. But the same action patterns may be involved in *will.* The type of instruction is usually different in the two cases. In voluntary patterns, it may have been largely situational, but in willed actions, the *I* meaning of self-instruction tends to dominate. Generally speaking, an individual who has gone through the unhappy stress involved in making some choice seems strongly inclined, other things equal, to push the resolved action through to an end. Since he has once decided, he usually does not wish to "re-make his mind."

b. The Place of Rules, Habits, and Goals in Willed Action. Action which conforms to established rule often assumes the characteristics of will. When an individual has lived and found satisfaction by rule, he normally tends to continue by rule. Very persistent intentions (strong determinations) often appear in this manner. Some men are definitely inclined to "stick to the rule" despite all opposition. The same may also be said of habit. "The breaking of a habit," we are often told, "is the test of a strong will." To most individuals, perhaps, the old ways are the best ways. Moreover, will appears when some remote end or goal upon which great value has been placed is constantly sought. Men may struggle on, undiscouraged and undaunted in the face of terrific odds, toward the final realization of some end or ideal situation. Such men often achieve greatly because they are persistent and tenacious[1] in their determination. We are reminded here of the remark of a successful Civil War general to the effect that he would fight his campaign out along a predetermined line even though it took all summer.

c. It May Be Ruthless. Willed action may often involve a relentless pushing forward toward the realization of an end (situa-

[1] According to Pillsbury, tenacity in holding to a purpose is probably inherited. Such a position, we believe, would be hard to defend.

tion) with a ruthless disregard for consequences. It is not at all strange, we hold, that some great men, who have invariably been described as being strong willed, have also been quite ruthless. Nothing was seemingly able to swerve them from their chosen course. One cannot imagine a certain type of general, reformer, or industrialist as being kind and gentle in his achievements — as never pushing other human beings around. It is probably true that the realization of any major goal is bound to harm a certain number of individuals. Every great change such as the introduction of machinery, the establishment of a republic, the shift from coal to electricity, the decline of agriculture, and a change in religion necessarily exacts its toll. In case of a besieged city, for example, the population may be reduced to the necessity of eating rats and insects. Many may possibly die; but the iron-willed general persists, despite such suffering, in order to achieve his aim. What is right, in so many cases, often seems to be a matter of the opinion (the will) of a few men. Many of the great industrial fortunes made in this country have been amassed through the suffering and the sacrifices of many persons who hold no share in them. The story of the old fur trade in the Northwest is covered with the blood of men who were ruthlessly murdered in order that a fortune might be made. The struggle to establish a slave-free world has been even more strikingly marked in this manner. And the histories of the Frick strike and of other similar industrial troubles make clear how utterly ruthless at times a few strong-willed individuals have been.

When a man, who perhaps has no other claim for recognition, has said, "I am right and God is on my side," no argument may possibly swerve him and nothing may stop him. He may, of course, be insane. Here, again, we secure an illuminating glimpse of will. Very often it is the slightly disordered individual or the one-track individual that may show the greatest amount of will. In such cases, when an end-satisfaction has been formulated, nothing, perhaps, can possibly evict it. Such individuals may indeed be wholly indifferent to any form of constructive criticism and friendly guidance. They simply do not care; and, furthermore, they do not change. Rule, choice, habit, ideal, goal, conviction, prejudice, intolerance, and actual disorder may be some of the contributory conditions serving at times to determine the strength and the weakness of the will of an individual. If we would

train for a strong-willed individual, these, generally speaking, offer the way. If we would train for a weak will, the same holds true.

d. Degrees of Will. An individual may be morally, religiously, or socially strong willed, and industrially or scientifically weak willed. A man may be strong willed in his office but weak willed in his home. In short, there is no such thing as strong or weak will *in general*, any more than there is action in general. In every individual, there are undoubtedly many unlike *determinations*, each of which is characterized by a definite *intention* to act in a given manner with respect to a certain object or situation. Some of these factors are unquestionably strong, and others are unquestionably weak. Some are very persistent, while others are not. The history of what an individual has done and the way in which he has met and settled his various problems is essentially the story of his will. Will, simply put, is a strong or a weak push toward a way or a particular form of satisfaction. Whatever condition contributes to or detracts from this push directly affects an individual's will.

OUTLINE

CHAPTER XII. AN EXPLANATORY APPROACH TO ACTION PATTERNS

A. An Orientation
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    2. Brain Surgery
    3. Post-Mortem Examination
    4. Brain Experimentation
  c. Types of Scientific Description
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    2. Psychological Approach
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CHAPTER XII

AN EXPLANATORY APPROACH TO ACTION PATTERNS

A. *An Orientation*

a. Neurology and Psychology. Having finished with our descriptive tasks, our thoughts turn logically to survey certain problems of explanation. In this task, we shall be largely concerned with a brief consideration of certain general phases of neurology and of psychology. An adequate explanation of action must necessarily include a discussion of nervous functions. At the same time, however, we must sensibly regard the significant contribution of an individual's history to the problem of understanding his actions. The quest here must necessarily be strongly tempered by a realization that a great deal more is known about psychology than about neurology.

On this point, Herrick has remarked in part that it must be recognized that much of fundamental importance for a true understanding of the nervous functions is at present beyond our reach. For example, the exact protoplasmic mechanism, by which the physical energies acting upon an organism are changed into vital processes of a nervous type, remains obscure. In fact, it is not perfectly clear how the organism is able to respond at all. Such problems as the *physiological* difference between a seeking reaction and an avoiding reaction, or why one and not the other is exhibited after a particular excitation, or why and how "the burned child dreads the fire," are still far from solution.

We have deliberately delayed until now our discussion of the central nervous system, with its various specialized or unspecialized sense-organs on the one side, and its muscular and glandular structures on the other. We have been content to refer briefly to those receptor organs about which definite scientific information is available. We have seen that no specialized sense-organs have been revealed to account in part for many of those perceptual

properties which characterize objects as a result of the nature of the relations which exist between a functioning organism and its environment. Of the various psychological properties of the objects observable on every side of him, man is quite sure. But of the non-psychological and contributory conditions of these, he is not so sure.

b. Sources of Information. We turn now to a consideration of the anatomy and the physiology of perception and action. Our account is analytic rather than synthetic. This is not a

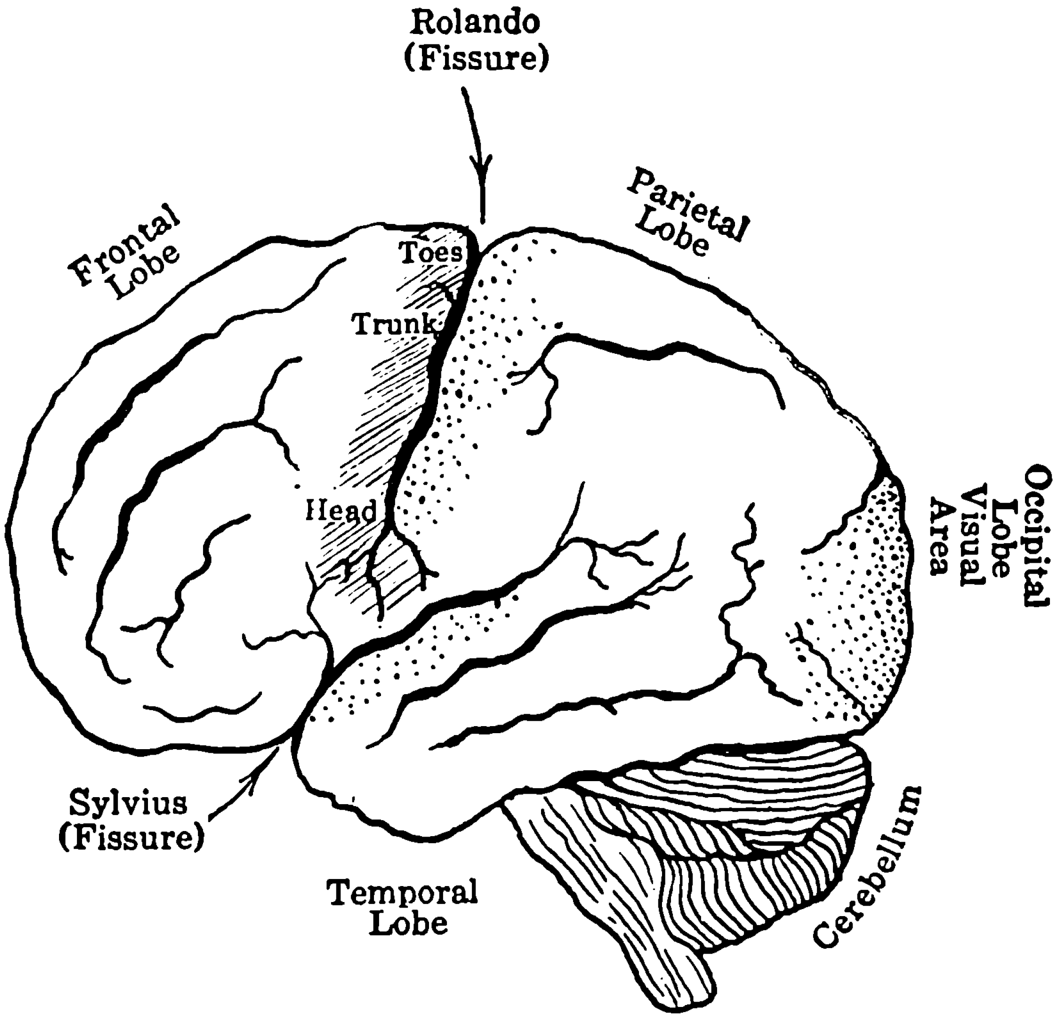

Fig. 74. Sketch of left hemisphere of human brain showing lobes, areas, and fissures.

matter of choice but of necessity. We recognize, therefore, that our account does not actually touch closely what is for us the most important side of the central nervous system, *namely*, its integration. But it is quite impossible to reduce a functional whole to its anatomical parts and thereby secure a knowledge of its *operation* as a unit. Since it is utterly impossible to tamper with the intact nervous system of man without danger of doing irreparable harm to it, reliable knowledge of "normal" neural function must be drawn largely from experimental studies of the functions of animals. With such data in hand, the gap between animal and man must then be bridged *by analogy* which is, at best, a rather frail structure for the amount of work it must do. It is

assumed, by analogy, that what is true of the subhuman functions is, within limits and within certain cases, similarly true of the human functions. It is probably true that such data contribute, when properly gathered and sensibly evaluated, to man's understanding of himself in his *simpler* moments. In addition to these experimental (subhuman) sources, a considerable amount of direct information bearing upon certain cortical properties of human beings has come through the reports of surgeons from their dealing with disorders (as in tumors), impairment (as in hemorrhage), and injuries (as in wounds) which involve the human brain. Information has also been derived from post-mortem examinations of cases in which functional disturbances were previously noted. In addition, weak electric currents have been applied to portions of the cortex exposed under operation and the resulting behavior observed. Since all such data are gathered from pathological cases their significance for normal human functions is necessarily limited.

c. **Types of Scientific Description.** It is recognized that the central nervous system is an inseparable factor in the determination of every *function* of the organism. The student recognizes that the organism shows many unlike functions. The functions of the lungs and the heart are totally different, for instance, from the functions of the liver and the spleen. These are again different from the functions of the organs of assimilation and excretion. The functions of the nervous system also vary enormously. Without it, even such life processes as growth and maintenance could not continue. But its service in these cases is quite different from what it does in perceiving, or in acting, or in thinking. It must be understood that a thing may be a *unit*, yet serve many unlike *offices*. The nervous system is a striking example. That it functions in many unlike ways, no one doubts. Yet the difference between its physiological functions and its psychological functions is enormous. We assume, without question, that the nervous system functions and produces the various *properties* and *characteristics* of the individual and environment which we call psychological. There is really no more to any psychological function than the way in which the nervous system works in a particular manner to produce a certain observable product. The stimulus, the changes in the nervous system, and the resulting product are inseparable as far as an understanding of psychological

function is concerned. Gastric functions, for example, are *defined and described* in part by what is done under certain conditions. Psychological functions are also *defined and described* in part by what is done under certain conditions.

For proper understanding, however, it must be admitted that there is a great deal more to psychological function than can be expressed in terms of what is known at the present time about the structural and functional properties of the nervous system, when the latter is considered in terms of the *nature* and the *rate* of the nervous impulse. The structure of the various parts of the nerve cell has been exhaustively studied for years; yet most of our knowledge must still be put in terms of *functional* properties of the whole cell. That is to say, the various divisions of such cells are most adequately understood in terms of function. Careful microscopic examination of the structure of such cells has repeatedly failed to show any reason why one part, for instance, should do one thing and another part should function in a different manner.

To avoid any possibility of misunderstanding, the writer wishes to state quite frankly that he knows very little about the nature of nervous matter. He realizes, moreover, that it is quite impossible in the light of the present state of scientific knowledge of "matter and the nervous system" to offer an adequate description of *human activities* in terms of the known properties of these phenomena. He has no doubt that when the final descriptions of the various properties of life shall have been written, an adequate understanding of the neural side of the psychological functions shall have been achieved. Our explanatory discussion here must proceed with these facts being understood.

B. *The Nervous System*

a. The Neural Impulse. *Its Properties.* In every experience of man, there is neural activity.[1] The essential feature of such activity is known as the neural impulse, which appears as a change that *progressively* involves or covers a part or all of the nervous system. This change which occurs in the nervous pathways lying between the receptor (sense) organs on the one hand and

[1] Nervous tissue is more irritable than any *non-neural* material. Muscle tissue, however, *responds* readily to changes in temperature. It finally ceases (becomes rigid) at high and low extremes.

the brain or the effector organs (muscles and glands) on the other to contribute to some function is so very slight that extremely delicate instruments must be employed in its study. At the present level of knowledge, the nervous impulse seems to show most unusual (unique) properties. Its rate of travel is considerably slower than that of the ordinary electric current. At the same time, however, it is often much faster than the spread of an ordinary chemical change such as may occur in the burning of a line of gunpowder. Yet, when apparatus which is capable of recording very minute changes is properly attached to a functioning nerve, it is found that electrical phenomena occur in it; moreover, careful tests also reveal certain chemical properties — there is a very faint trace of carbon dioxide production as well as a very small amount of oxygen consumption. But, strangely enough, constant stimulation over a period of hours produces no discoverable reduction in either the rate or the amount of the neural impulse. It is, indeed, very difficult to produce nervous fatigue. The nervous impulse, like some chemical reactions, shows, furthermore, a dependence upon temperature. When a nerve tract is cooled to around zero (centigrade), it ceases to function. About this same temperature muscle tissues also become non-functional (non-irritable.)

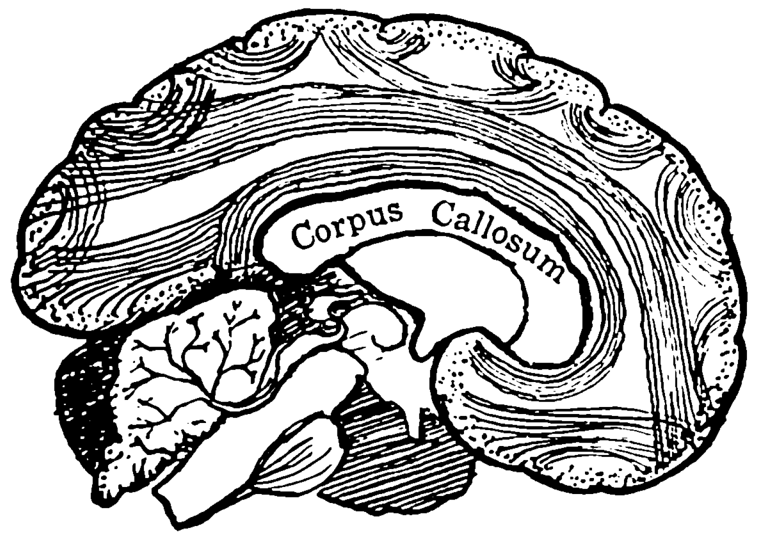

FIG. 75. Diagram showing association fibers and place of crossing of commissural fibers.

There is, furthermore, considerable variability among different nerves in the speed at which the neural impulse travels. In some cases it is relatively fast; in other cases, it is very slow. Large differences of this sort occur among different species.[1] Again, the frequency at which these electro-chemical impulses (waves, or changes, or discharges) follow each other along a particular nervous pathway also varies rather widely (about 5 to 200 per second). In many cases of voluntary action, the average number is around

[1] Its rate varies greatly — from approximately 3 to 300 feet per second — among different organisms and along different pathways. Along many motor pathways in frogs, it moves at about 100 feet per second. Their sensory pathways are probably much faster.

70 per second. An *increase* in the intensity of the stimulus applied to sense-organs is assumed by some students to be followed by an *increase* in the number of waves passing along the pathways during any given time. This increase may partly account, when an increase in intensity is the sole change made in a stimulus, for a change in a perceptual property of an object. Or, it may mean the difference between functional and subfunctional levels. Perhaps the only *neural* (not psychological) difference between such properties as warmth and pain, or mild and strong pains, may be put in terms of these frequency differences. Theoretically speaking, one type of stimulus might produce one level of functioning, that is, one frequency rate of neural impulse, while another form of stimulus might produce a different frequency rate. We recognize, at least, a difference in functional tuning whereby a weak stimulus will, at one time, apparently produce a nervous change while at another time it will be wholly ineffectual. Since we have previously discussed this general matter of functional tuning, we shall not dwell upon it here. One or two other general features of neural conditions must be considered.

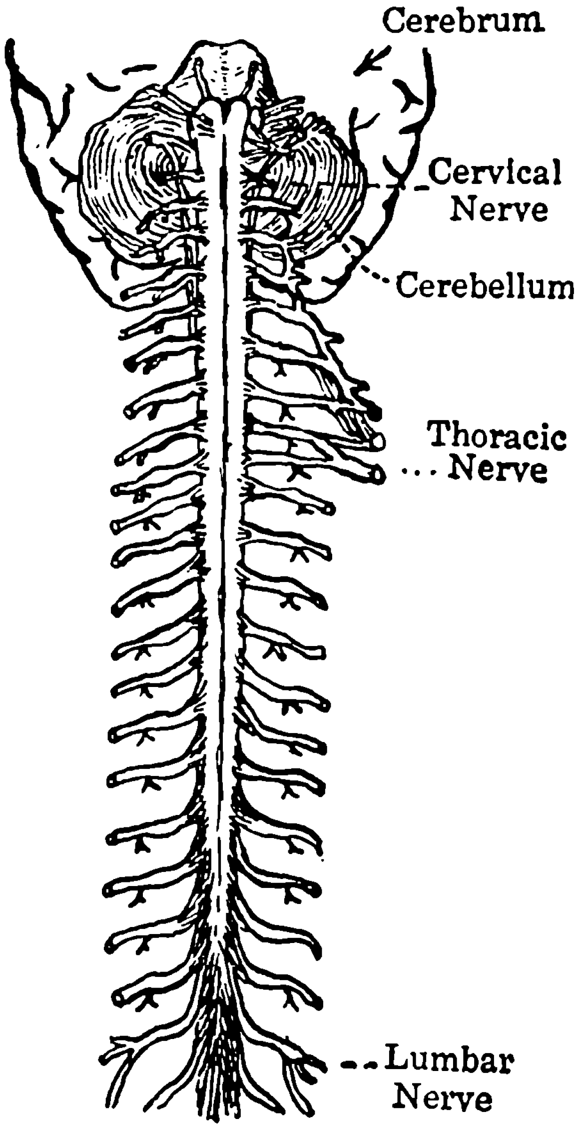

FIG. 76. The segmental pairing of spiral nerves.

A short period, which is known as *initial lag*, exists between the application of the stimulus and the beginning of neural change. Again, when the stimulus is removed, neural functioning does not instantly cease. This phenomenon is known as *terminal lag.* Furthermore, since neural conduction is assumed to take the form of successive waves there is also a short period — the *refractory period* — following each wave during which time the stimulus energy, although acting *continuously* upon sense-organs, has little or no discoverable effect. The various differences in intensity to be found among the perceptual properties of objects are often referred to a difference in the total number of nervous pathways (fibers) involved at any given moment. This seems to imply that the intensity

of the perceptual property may be increased by increasing the total stimulated area. There is, however, little experimental evidence to substantiate this assumption. Finally, the intensity of the nervous impulse itself, when measured by delicate apparatus, seems under specific conditions to be fairly constant for a *particular* pathway. It is, at least, independent of the stimulus. Although the stimulus, for example, may be either weak or strong, the value of the neural impulse may remain the same. If the pathway is partially blocked by an anaesthetic and the impulse succeeds in getting through, it shows the same properties (voltage) on either side of the barrier. This particular phase of nervous conduction is known as the *all* or *none* law. With an understanding of these facts together with the general warning that neural impulses tend in every case to involve, in varying degree, the whole nervous system of an individual, we proceed to a consideration of reflex, random, habituated, and purposive activities.

b. **The Reflex.** Reflex movement is a functional product. But in its simplest form it is entirely physiological. It is physiological in that it is not meaningful. Moreover, it is not subject to control by the individual. Thus it may occur in *light* sleep and in many cases when an individual is anaesthetized. It may occur when the brain is cut off from the spinal cord, as in the case of a broken back. Reflex behavior, then, is to be placed with various other physiological products. But it is not to be regarded with such functional products as goals, ideas, plans, color, locality, familiarity, and purpose. The products of psychological functions are meaningful. The products of physiological functions are not. Stomach and spleen functions, as in the reflex, do not refer to environmental objects and situations.

We assume that a *simple reflex*, such as the knee-jerk, may be *partly* explained in terms of neural structures and organic functions in the following manner. When physical energy in an amount sufficient to raise the organism to a functional level is delivered by a blow upon the knee, a nervous change (not a stimulus) occurs which involves a neural pathway extending from the knee into and through the spinal cord and out to the leg muscles. Under this contraction, the forward thrust of the leg occurs. The direction of this unified neural pathway, or functional unit, which is commonly called the reflex arc, is diagramed in Fig. 78. Inasmuch as the nervous system of a human being does not work in any

sense in this simple piecemeal fashion, this diagram is, of course, purely schematic. Here is represented the sensory or afferent fibers (A) that lead without structural *break* (or junction) into the spinal cord. At that place other fibers, which lead unbrokenly to the muscle, become involved. These are the motor or efferent fibers (B).

Functional-Anatomical Units. These neural fibers, while quite long in some cases, have a very small diameter. They combine, usually in enormous numbers, to form *nerves* which are, as a rule, sufficiently large to be perceived under dissection. Figure 76 shows some large spinal nerves (each containing an enormous number of fibers) which branch off in pairs at various levels along the spinal cord. One of these nerves extends down the arm and gives off branches along the way. Of necessity, it approaches the surface of the arm at the elbow, where it may be easily stimulated by squeezing to produce the psychological properties observed in the "funny bone" experience. Another nerve (trigeminal) passes to the head. Its distribution over the face is shown in Fig. 77. Other things being equal, A and B of Fig. 78 constitute, as far as reflex behavior is concerned, the "functional unit" of the nervous system. That is to say, many thousands of these pathways coöperating intimately may produce a reflex movement. A or B is also known as a neurone or nerve cell. Such cells are the "anatomical units" of the nervous system. The nervous system, viewed structurally, is composed, like the rest of the body, of single cells.

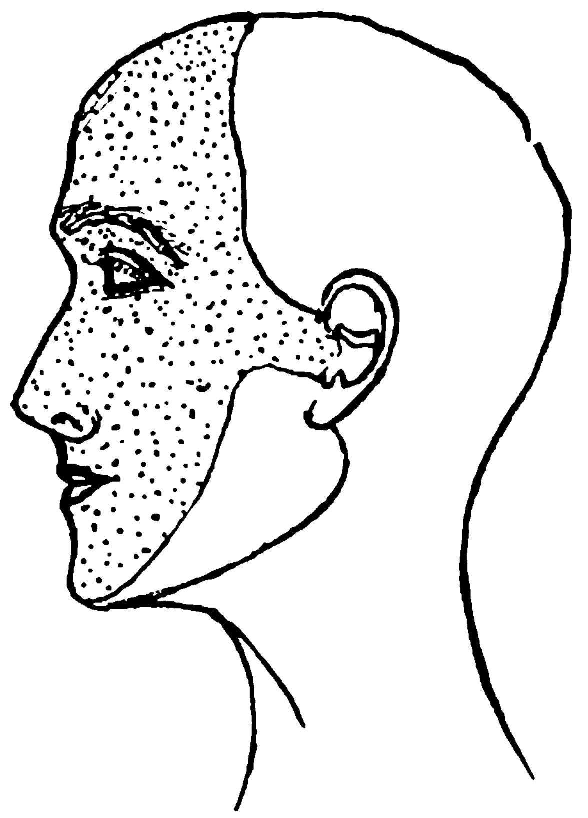

Fig. 77. Facial branch of the trigeminal nerve.

The neurone diagramed in Fig. 78 has a long slender trunk (axon, a), a cell body (c), and fine hair-like endings (dendrites, d). Generally speaking, the axon is long, while the dendrite is short. But the former may be short, while the latter may be long (two feet). The student can well imagine the task he would face in pulling these long microscopic fibers, one by one, out of the nervous system, when he realizes that the latter is literally composed of many billions of such structures.

c. The Synapse. The place of functional contact (S) between any two neurones (Figs. 78 and 79) is known as the synapse. The synapse is functionally significant because it is polarized. It has, among other uses, to permit the nervous impulse to progress across it in one direction only, *namely*, from the end-brush of the axon of one neurone to the dendrites of another neurone. It may not, of course, permit the nervous energy to pass at all. It may block its passage. Moreover, the difference in the degree of resistance offered by the synapse to the nervous impulse may vary considerably either in the same synapse under different conditions or among

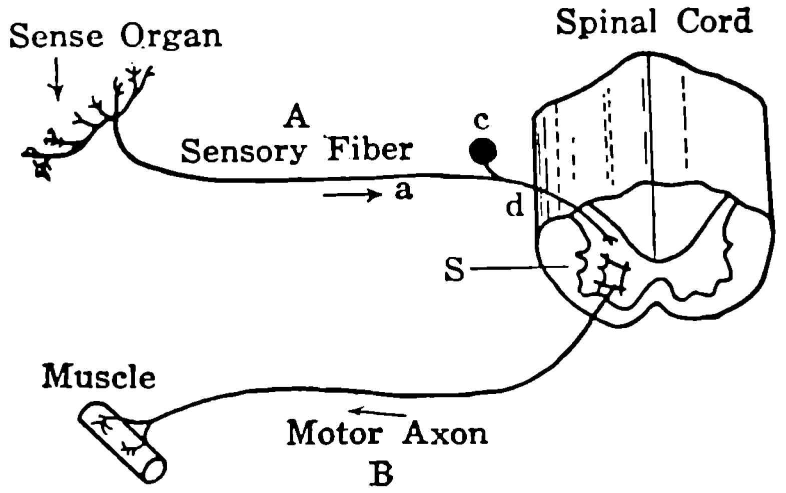

FIG. 78. Here is a receptor-conductor-effector unit involving a synapse (hypothetical).

different synapses at the same time. Furthermore, the resistance may be either increased (raised) or decreased (lowered). In every case, however, the total time required by the nervous impulse to reach its destination in some muscle is increased merely because it must cross a synapse, although it is considerably greater when the synaptic resistance is raised. As a possible result of this assumed difference in resistance at the synapses, the nervous energy may be allowed to continue in a particular direction over old pathways or it may be turned aside to flow in a different direction along new pathways.

Everyone grants that the nervous impulses cross the synapses. But the exact manner in which these physical gaps, tiny though they be, are negotiated is quite unknown. If it were an electric charge (current), the neural impulse might possibly jump the synapse as a spark leaps a slight break in a wire. Regarded in terms of its chemical properties, however, the impulse must necessarily get across in some other manner.[1] It has been suggested

[1] We speak of physical and chemical properties of the nervous impulse because such properties are not observed. They are studied and known in terms of the

that the neurones may move momentarily into physical contact, thereby permitting chemical passage to the nervous impulse. Furthermore, it is not at all clear why the nervous impulse should spread in part along one rather than along another division of the nervous system. It is possible that, electrically regarded, the discharging rate of one pathway may be more nearly like the rate of another. For instance, two neural pathways — one incoming and another outgoing — may thus be quite alike in their frequency. If the individual neurones actually move, the problem of synaptic crossing is less difficult of understanding. At the same time, however, the vexing problem of why some neurones move at a particular moment and others do not immediately arises to present an even more baffling face. Consider the case in which an individual sees an object lying on the walk before him. He turns it over with his left hand, then pushes it slightly aside with his right foot. Why certain synapses should possibly close (assuming that they do) while others should open (he does not move both arms and legs) remains unexplained.

We wish to suggest at this point that all the central pathways are possibly alike in strength in the beginning and that they remain this way until the end. In this way we may more easily account for the general random, diffuse behavior of the child. We can also account for the sudden diffuse behavior of the adult who, under a certain state of preparation, may act very violently or become quite rigid (involving practically all his muscles) at a whispered command or a slight touch on his shoulder. The *stimulus*, it will be noted, *does not need to be strong* in any physical or chemical sense to produce such actions. Every case of startle shows this condition. Or, if an individual is called upon to speak before a crowd, he may twist, squirm, grow red in the face, and mumble inaudibly, thus showing that the nervous energy is spilling out over many pathways to many muscles. In terms of this fact we can also understand that many different neural ways of *attaining some desired end* actually exist during the early years of an individual's life. For example, the young child will reach toward an object (in a certain position) with one hand about as often as it will with the other. Under normal conditions of development,

way they reveal themselves in physical and chemical tests. An electric apparatus is used to study the physical properties, and delicate chemical tests reveal the presence of chemical changes.

the one hand comes finally to dominate the other. This domination is apparently cortical; it is not a matter of muscular structures or of high or low synaptic resistance below the cortex. To understand this particular form of domination is to understand cortical functions. We know, for example, that for some reason, social as in the case of one dirty hand, the clean hand may be instantly used. The use or domination of one hand in this way must necessarily be regarded in terms of an *end* to be reached in a particular situation. What is true of this particular illustration is essentially true, we suggest, of all the important action patterns of the normal individual. The quest for a difference in synaptic resistance *below the brain* as an explanatory basis of the many activities of a human being must necessarily be fruitless. The primary locus of all neural development and control is in the head — not below it.

While such behavior is in no way reflexive, we know that if one hand of an individual is tightly held, the free one can be brought instantly into play; if both are held, other structures of the organism such as the feet, the body, or the head can be employed. The nervous energy of the individual may normally be turned for shorter or longer periods to any particular set of the muscles of the legs, arms, or head to produce action which aims at bringing the organism to some form of satisfaction. The number of such possible action combinations is quite enormous.

d. Peripheral and Central Portions of Nervous System. The portions of the nervous system which lie outside the brain and spinal cord are commonly called *peripheral;* they are mainly sensory and motor pathways. The brain and spinal cord constitute the *central nervous system.* They are major nervous *centers.* It is in these regions only that the wide distribution of neural energy over many pathways can occur. Neural impulses which come to the central nervous system over the afferent pathways from every portion of the organism may possibly be inhibited so that no action occurs, or they may be ordered in such a way that many precise, directive actions occur over a relatively long period. Neural impulses which enter the spinal cord from sensory pathways (neurones) are directed upward along pathways to end possibly in the region of the thalamus. The functions of the thalamus are not well understood, but it is usually assumed to exercise a certain degree of control over the *intensity* of the impulses which

must pass through this region in order to reach the cerebral cortex. When synaptic resistance is presumably lowered here, as in case of a diseased condition, too much energy for normal action may possibly be delivered to the cerebrum. The behavior of the individual may not only be heightened to an abnormal degree, it may also become diffuse and random, that is, unnecessary movements may be made.

1. *Sensory and Association Areas on the Cortex.* From the thalamus, the neural energy may pass to the various sensory areas of the cerebrum. Figure 74 shows these several areas. Visual impulses go in part to the occipital lobe at the back of the brain. A pathway which extends from the toe to the cutaneous sensory area on the cortex is shown in Fig. 79. This area for the various cutaneous, internal, and kinaesthetic impulses lies in the parietal lobe. Impulses which originate in the cochlea of the ear reach the temporal lobe. The areas for taste and smell are located on the surfaces to be seen when the left and right halves of the cerebrum are pulled apart. Surrounding each of the sensory areas of the cortex is a more generalized region to which, theoretically speaking, no nervous energy comes *directly* from the sense organs by way of the thalamus. These are the association areas.

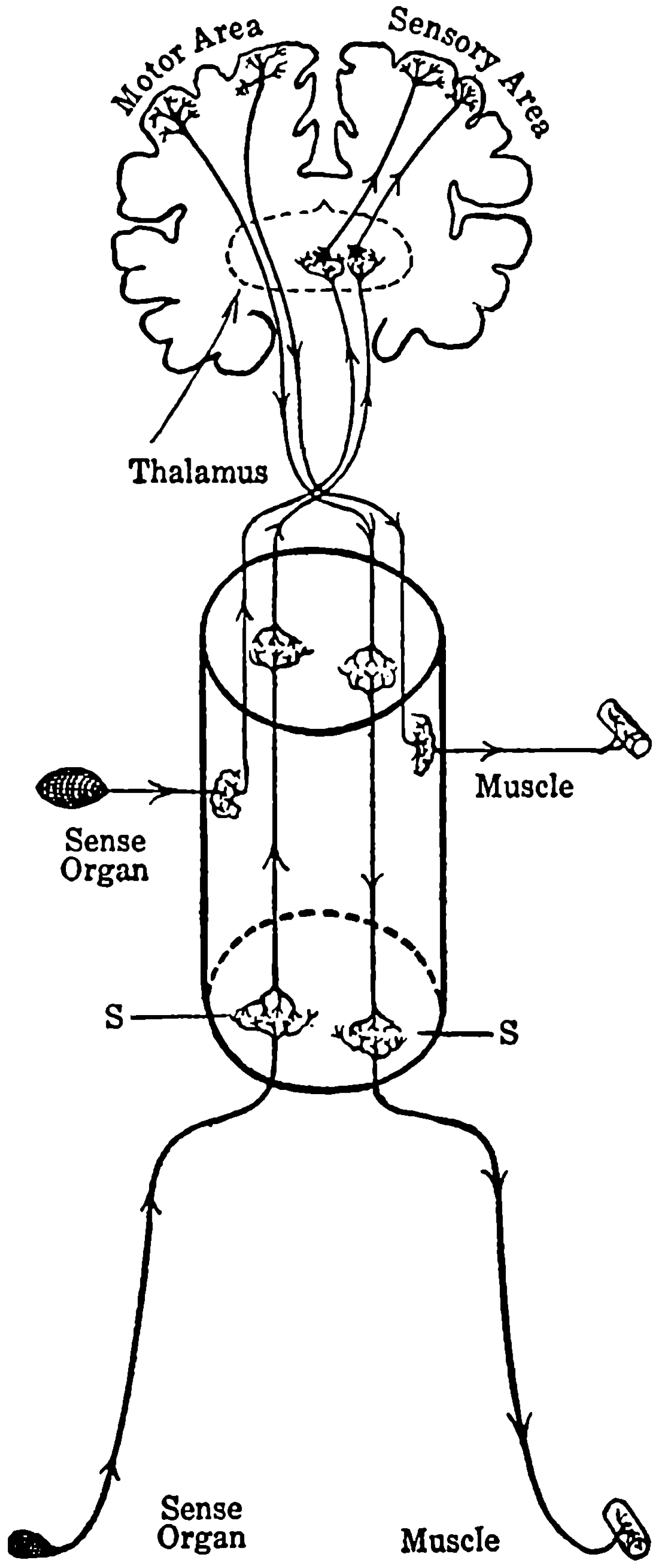

FIG. 79. A sketch showing neural structures and pathways.

2. *Projection Fibers.* From the frontal lobe and just before the fissure of Rolando, many pathways originate and lead straight down through the thalamus (see Fig. 79), to cross to the opposite side at the top of the spinal cord or at the base of the brain, and to end finally at various levels within the spinal cord. Some of

these stop in the thalamus, where new pathways originate to lead to the various effector organs. Others involve the cerebellum and, indirectly through it, many of the muscles of the head and trunk. The nervous energy which flows from the motor area down along these countless pathways — which involve what are known as projection fibers — may continue out over the efferent routes to produce action. Electrical excitation of portions of the motor area may be followed by *varying degrees of coördinated movements* of different members. When that part of the motor area which borders *directly* upon the fissure of Rolando is destroyed, temporary paralysis usually results. When the more remote portions are affected, paralysis does not follow, but the individual is more clumsy or awkward in the execution of action patterns. When more extensive lesions involving essentially the entire area occur, permanent losses in ability to act usually result.

3. *Other Pathways.* Each of the various cortical areas within either hemisphere is connected with every other part by many millions of association fibers. Nervous energy from any one of these regions may directly involve the *motor* area, and thus indirectly involve many bodily effectors to produce action. Each part of one hemisphere is also directly connected with each corresponding region in the other hemisphere, and indirectly, in this way, with every other part. The millions of commissural fibers which pass, closely packed, through the *Corpus Callosum* (see Fig. 75) establish these connections between the *two* hemispheres. By means of the projection (incoming and outgoing), the association, and the commissural pathways, all parts of a living organism are intimately related in a functional manner to all other parts. Regions which are structurally remote from each other are functionally near. There is a high degree of functional interdependence. The student must understand that under such conditions piece-meal functioning is quite impossible. Instead of a few neurones being active together to produce action, there are many millions. The nervous system thus stands as a great integrative agency of the organism.

4. *Cortical Integration.* Perhaps the most outstanding characteristic of the brain and the rest of the central nervous system is its integration. Although it shows structural differences from region to region, it seemingly functions within limits as a unit or as a whole. Experimental data gathered from animals and

pathological (clinical) evidence obtained from man seem to point in this direction. Franz, for example, removed a part of the motor area from the left side of a monkey's cerebrum, thereby inducing paralysis in the right arm of the animal. By binding the undisturbed (left) arm to its side in order to prevent the animal from depending upon it to secure its food or, in other words, to make the animal use its paralyzed arm, Franz quickly (one month) brought the paralyzed arm of the animal back to a normal functional condition, although the operated brain area was not structurally restored. A later operation on the right hemisphere was made with resulting paralysis in the left arm. A normal functional condition again reappeared. In this case, both cerebral hemispheres were structurally impaired without permanent functional impairment. It would seem, therefore, that the brain, working as a whole, took over functions which under normal conditions were more directly controlled by particular cortical areas. Such studies also indicate the absence of any precise dependence upon one bodily way of securing satisfaction. When the employment of its arms was suddenly canceled by this operative technique, the monkey immediately resorted to the use of other members, for instance, its hind feet or its tail in securing food. In this connection, we are reminded of Lashley's rats which, after being operated on, immediately shifted *without practice* or *learning* to wholly different patterns of behavior, thus involving the organism in an entirely new way.

5. *Some Results of Lashley's Experiments on Cortical Functions.* By means of operative technique, Lashley has made very significant contributions to our understanding of cortical functions in the subhuman. For example, he taught white rats an action pattern which involved visual discrimination (between two unequally illuminated pathways) in order to secure food. He then removed the cortical visual areas from his subjects When these operated animals were retested, the former discrimination pattern was found to be completely lacking. The pattern, *in this respect,* was definitely localized. But significantly enough, the same animals were able to re-establish the same pattern without a greater degree of difficulty than was shown in the beginning when the cortical areas were wholly *intact.* Using other rats to show this, he removed the visual area before starting his experimental tests. These animals, although now lacking a part (entire occipital

third) of their brain, seemingly established their visual discriminatory patterns as easily as did cortically normal organisms. The pattern in this respect was not localized. The destruction of the posterior third of the cortex, therefore, had no effect in these cases upon the acquisition of an action pattern leading to satisfaction. Moreover, after learning had occurred, retention was as good in these animals with a structurally impaired brain as it was in other animals with an intact brain. It would accordingly appear that the formation of a visual discrimination pattern of this sort depends upon the occipital area in a normal animal, but in those animals from which the visual area has been removed such dependence does not exist.

Lashley also taught some of his operated and some of his non-operated animals to run certain mazes. From his results it appears, in general, that the establishment of such action patterns is directly dependent upon the functional integrity of the whole brain. When the amount of cortex was operatively reduced, beyond a certain point, a longer time and a larger number of trials were needed and more errors were made in the acquisition of the action pattern. When the maze pattern had once been established in a normal (non-operated) animal, its retention did not appear to be dependent upon any particular part of the cortex. *The removal of one part entailed no greater loss than did the removal of another part.* No one part seemed to be peculiarly important. Retention seemed to depend instead upon the total amount — total mass — of brain area left intact. When less than 10 per cent of the total brain area was destroyed, regardless of the location of the particular area, the maze pattern was not significantly impaired. In most cases, the removal of more than 15 per cent of the total cortical area of the brain, regardless of the location of the particular area, greatly impaired or completely destroyed the maze habit. The effect was more a matter of the quantity destroyed and less a matter of place of destruction. Individual differences appeared among the various animals. In some cases, the removal of larger amounts of cortical material seemingly produced losses no greater than those obtained with other animals in which there was less cortical destruction.

One very significant conclusion may be drawn from these experimental studies upon cortical functions. It is significant because it stands strongly opposed to a common notion concerning

the neural basis of acquired behavior patterns. In terms of this theory, an action pattern of an animal, such as is involved in running successfully through a maze in which various turns must be made and blind alleys must be avoided, has been assumed to depend upon a number of independent reflex pathways. One particular turn in the maze is thus held to depend upon one particular pathway in the central nervous system, while a second turn depends upon a second cortical pathway, etc. In a particular maze pattern which involved, let us say, ten turns to be made from beginning to end there would be, to put the matter very simply, a basic neural pattern of ten different reflex — anatomical — pathways through the brain. Turn number five, for example, would correspond to reflex number five. By gradually cutting into various areas of the animal's brain, one might legitimately expect, at times, to cut (nick) a particular section of a neural or brain pattern in such a way as to affect *some* but not *all* of these reflex pathways. Thus by cutting neural pathway number five, turn number five of the maze would be either impaired or totally destroyed. But the other reflex pathways and the other maze-turns up to number five would be quite unaffected. The experimental results clearly indicate, however, that a maze pattern cannot be impaired or lost in pieces or in parts. The removal of a bit of cortical material either *impairs the whole action pattern or leaves the whole pattern quite unaffected.* Such results seem to indicate that the determination of action, even at the level of the rat, does not reside to any significant degree in specific reflex arcs. It must be put instead in terms of the functions of the whole cortex (whole brain).

6. *Evidence Derived from Human Beings.* Pathological or clinical evidence obtained from human beings upon the problem of cortical functions is more ambiguous. A brain tumor, a hemorrhage, or an injury may have a very wide-spread effect upon the ways in which a human being perceives, imagines, understands, thinks, and acts. Or, the functional effects may be somewhat limited. There is the rather interesting case of Cusick who is reported to write "gags" for Durante, Cantor, Bernie, and others. He became totally blind at 16 as a result of a head injury. Almost fifteen years later, following another head injury, his sight partially returned. In addition to blindness, he has also suffered at times both deafness and mutism. Again, in case of brain tumor there

may be only partial paralysis, partial blindness, or partial deafness together, possibly, with lesser accompanying symptoms. For purposes of understanding, the major difficulty in many of these cases concerns the problem of proper diagnosis or of study. By the time an individual reaches a clinic or the hands of some trained observer who is capable of making a careful study of the nature or the degree of his various functional disturbances, he has usually progressed quite far in his affliction.[1] In many cases, an examination can be made only after death. It is indeed difficult to relate structural disturbances discovered after death to possible functional symptoms existing before death.

In general, this much seems evident: When a particular sensory region such as the visual area in both hemispheres of man is completely destroyed, visual perception is thereafter impossible. If the whole optic nerve from one eye is broken or seriously injured in any place before it reaches the base of the brain just below the thalamus, the entire eye is blind. After the optic fibers enter the brain, an injury which is not too extensive may show partial blindness. Just below the thalamus the pathways from the two eyes are so distributed that when they proceed (making synaptic connections in the thalamus) to the visual brain areas, all the pathways from the *right* sides of the two retinas reach the visual area in the *right* hemisphere, while all the pathways from the *left* sides of the two retinas reach the visual area in the *left* hemisphere. An injury which affects a certain part of the thalamus, or the right visual area of the cortex may produce a functional impairment of the *right side* of each retina. As a result, an object in the individual's *left environmental field of vision* might not be perceived (left hemianopia). Any disorder of a part of the optic tract or of a small part of one visual area may result in a functional disturbance in a small portion of the visual field. This is similarly true, in general, of other forms of the perceptual functions.

When other areas of the cortex become diseased or injured, an individual may become unable to speak either all or some words. He may be able to speak, but only incoherently. As a result, his words may not appear as understandable patterns to other human beings. Or, he may use improper words. Under these conditions,

[1] One of the greatest hockey players of all time recently died at the age of 29 with brain tumor. It was assumed until just before his death that he had a serious kidney disease.

however, an individual may actually be able to write that which he would like to speak. In other related forms of disturbances he may be unable to make certain movements, as in writing, although he can possibly make those involved in handling objects. These troubles of speech and action are commonly known as motor aphasia. They are assumed to involve the association regions of the cortex, especially those which more closely surround the motor areas. In other cases, perception may be largely, or wholly concerned (sensory aphasia). The individual is able to perceive certain properties of objects, but not others. He may be unable, for instance, to compare environmental objects in terms of their color; or, he may be unable to perceive melodies, although he may still perceive other auditory properties. He may lose his ability to *understand* spoken language or to read. In these cases, however, he has gone beyond perception. Head remarks that aphasias are disturbances both of language and of thinking.

Present experimental and clinical evidence indicates that some psychological functions may be more closely related than other functions to certain divisions of the cortex. The unimpaired brain functions in one way, the impaired brain in another. Such functional properties as perception and action may be disturbed by *localized* brain injuries. But other areas with time will apparently assume, within limits, these same functions. There may be new structural changes — new brain development within the uninjured regions — to account for such vicarious functioning. Or, it may be that the *remainder* of the *whole brain* after the shock of injury has disappeared simply carries on in much the same way as before. Such functions as memory, imagination, and thinking cannot be localized in this manner. They seemingly depend more upon the functional integrity of the *whole* brain.[1] Intelligence, according to Lashley, seems to depend largely upon the *total mass of uninjured cortex.* When too much brain is removed, permanent impairment results. The rate and the amount of learning, for example, are definitely affected.

In closing this part of our discussion, we wish to cite the following illustration which is taken from Hoover, who has written illuminat-

[1] The whole right lobe of a man's brain may be removed in the morning and he may be conversing normally in the afternoon. Or, he may read, write, and learn. There may be no delusions, hallucinations, loss of memory or time or place references. See Dandy, E., "Physiological Studies Following Extirpation of Right Cerebral Hemisphere in Man." *Bull. Johns Hopkins University, 53,* 1933.

ingly about life in the White House under many Presidents. One can learn a great deal about psychology from reading his accounts. About two months after Taft's inauguration, he remarks, Mrs. Taft became very ill. Following a period marked by almost complete helplessness, she partially recovered. She had lost, however, as one result of her troubles, her former ability to speak understandingly. With President Taft as her "patient, devoted mentor," she slowly established again her language patterns. But she was no longer "the spirited woman she had been, nor was she able to resume the place she had designed for herself." This tragedy apparently laid a heavy burden upon the President, and partially explained some of the many changes that came over him during these years.

e. Random Actions. Whenever the cortex is functionally involved in the very young child many unlike action patterns appear, each of which is apparently non-reflexive. As we have remarked, any form of stimulation of the very young child immediately results in the production of a great variety of movements such as the throwing out, turning, and pulling back of the arms; the opening, twisting, and closing of the hands; the kicking, jerking, and thrashing of the legs; and the twisting and squirming of the head and body. Moreover, where there is no determinable form of stimulation, as in the case of a non-hungry, non-thirsty, non-sleepy child, such behavior is also observable. From these diverse random movements come finally the many thousands of directive and controlled actions to be found in the adult. Precision in action pattern is a matter of psychological and neural development. The individual's early attempts at controlled activity are clearly abortive. The child repeatedly reaches and misses. Its actions are, at first, both slow and clumsy. They are strikingly like those of a normal adult who is very cold, or of an abnormal adult whose cortex is diseased. The arms and the hands move, but they seemingly do so only with the expenditure of considerable effort. Where earlier, or under other conditions, the child's arms might have slashed rapidly and almost "wildly," they may now come hesitantly and almost gropingly toward environmental objects. Figure 80 shows the development of arm control as measured by the distance traveled in A without touching sides (Wellman).

For some little time, much of the musculature of an individual is unnecessarily involved in every action pattern. With increased

development many of these drop out. Others may, however, remain to constitute an integral part of the total pattern, although they seemingly make no contribution to the efficiency and the happiness of the organism. Their presence in adult patterns is to be attributed largely to the fact that during their establishment the individual was much more concerned with the particular *end* to be achieved in a situation than he was with the particular way in which to achieve it. Consequently, the various movements, being wholly secondary in importance to the *goal* or the object to be reached, were not regarded for their own sake. This is particularly true of most, if not all, patterns acquired during youth. In fact, as we have remarked, many of the ordinary action patterns of an individual are normally laid down long before he has become critical.

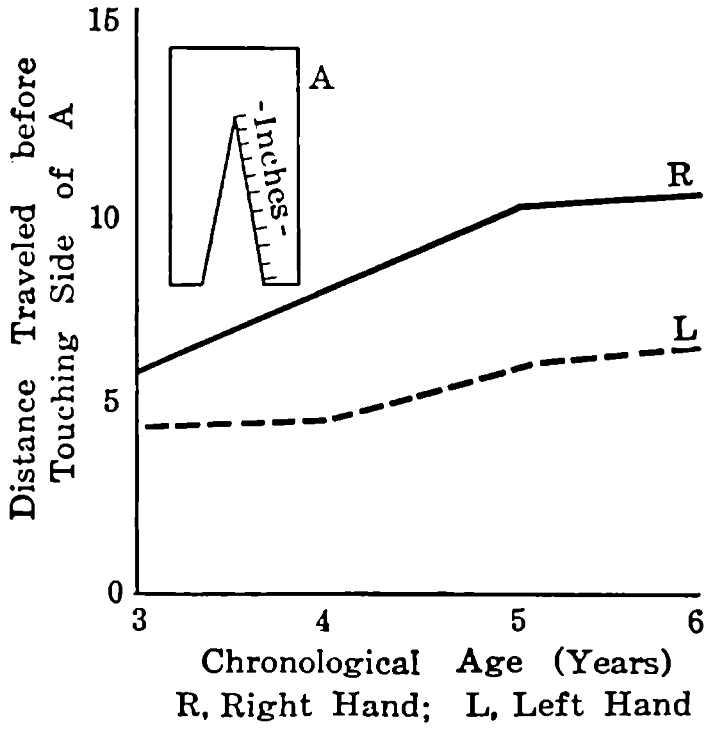

Fig. 80. Functionally regarded, the two hands show fairly uniform development.

When an individual's patterns are established during his mature years, the particular end (form of satisfaction) may still so dominate him that he may be unwilling or unable to evaluate sensibly the particular means whereby it is attained. In this manner we are able to account for much of man's inefficiency. But the neural basis of action patterns can unquestionably be changed in the majority of cases when the particular *end* to be achieved really *demands* that such changes be made. If an individual can be brought, by a shift in his motivation, to desire greater efficiency, and if he can be shown the proper way to such achievement, he will normally be able to modify his neural patterns by the elimination of some items and by substitution of other factors. His nervous system seemingly retains its original potentialities for change. Most of the opposition of an individual to change is accordingly not neural; it is psychological. The average person has no wish or need to change, once he has definitely established a particular way that satisfies.

f. Purposive Actions. It is assumed, of course, that a neural basis exists for every action. But the exact manner in which so

many totally unlike neural patterns may possibly be employed from time to time in order to reach some particularly desired object is quite unknown. Man and animal do struggle toward perceptual objects that offer satisfaction. Man, too, struggles toward imaginational and temporally remote objects that are desirable. If science possesses extremely little knowledge of a specific nature concerning the problem of the neural mechanism underlying the simple reflex, it possesses even less information concerning the specific rôle played by the nervous system in purposive activity. Science does know, however, that it is an absolutely necessary factor in all these cases. But specificity of stimulus, of afferent pathways, of central pathways, of efferent pathways, and of muscles is apparently quite lacking here. A man understands that he desires to reach or obtain a particular goal or object. Now, if he is denied some one way to this source of satisfaction, he normally seeks and not infrequently finds another way. If blinded, he uses touch; if paralyzed, he drags himself; or, if frightened, he seeks renewed courage in alcohol. The very significant influences of such factors as drugs, fatigue, sleeplessness, hunger, and cold upon the action patterns of human beings are observable upon every hand. Yet it is seemingly impossible to give any adequate description of them in terms of neural functions. In general, then, we recognize that while the object of satisfaction itself may be very important, the particular way to it may be wholly unimportant.

What is true of human beings in this respect seemingly holds to a lesser degree with subhuman organisms. Concerning certain phases of his experimental work with intact animals which had established a maze pattern in a perfectly normal manner and which had then been operated upon, Lashley comments in part: One animal may now drag himself through the apparatus toward food with his forepaws; another may fall at every step, but get through to the end by a series of lunges; a third may roll over completely in making each turn in the maze. If the customary sequence of movements in reaching the food is rendered impossible, another set, not *previously used in the habit* and *constituting an entirely different motor pattern*, may be directly and efficiently substituted (p. 137). Such results are very significant. From them the understanding student will be led to realize the gross inadequacy of any explanatory approach which seeks to reduce the activity of an animal to simple independent reflexes which are chained together

to form a total pattern, or to simple mechanical habits released by a specific stimulus (physical and chemical energy). In every case, it is the particular object (goal) which must be considered. The way (behavior) itself is to be considered in terms of the end situation. The end is specific; the behavior may or may not be.

For an adequate understanding of many cases of human behavior, some form of psychological causation is more important than forms of non-psychological causation. Every sensible individual recognizes that a major change in the character of his intent, desire, ambition, or motive may be directly accompanied by a change in his behavior. The several conditions of conflict, thwarting, struggle, indecision, and inadequate satisfaction unquestionably leave their permanent impress upon the organism. Each is important for an adequate understanding of human activities.

Generally speaking, since man's behavior toward objects is always related to such psychological phenomena as purpose, striving, and desire, a change in any one of them is significant. When the diet of an organism becomes limited, very persistent hunger for a particular kind or type of food usually appears. Under such conditions, only one kind of food will normally satisfy. One cannot, for instance, satisfy a craving for candy (carbohydrates) by eating mashed potatoes (carbohydrates). But neither the hungry individual himself nor another human being can offer a sensible scientific description of the nature of the neural or organic change which may be assumed to occur in the organism to account, in part, for these striking cases of particularized hunger. And, even though some scientist could give such a description, it would not be a description of the desire or the hunger. Each is a psychological property which must be regarded as being unique.

It would accordingly appear that a very detailed description of possible stomach contractions and of all related physiological phenomena can shed no more light upon some strong craving for sweets, or salt, or relish[1] than it can upon an insistent craving for alcohol or a drug. Yet as a possible result of his craving for a drug, an individual may kill in order to satisfy himself or to rid himself of the persistent, nagging need.

[1] In the Siberian wastes, where all ordinary sources of "relish" are completely lacking, natives commonly use rotten fish to satisfy their hunger for pungent, "spicy" food. This need is in part a desire for a change — for something different.

We unhesitatingly assume, without fear of being unscientific, that a desire or a longing for something, a dislike or a fear of something, an ambition or an intention to do something, other things being equal, will directly serve to determine human actions. We do not mean to imply, however, that a desire in the absence of intelligence or that an ambition unaccompanied by legs will produce a genius in the first case, or an aesthetic dancer in the second case. But we must admit psychological explanations into our understanding of an individual's actions, if we are to proceed sensibly with the various important tasks of training him properly as a child and of relieving him therapeutically as an adult.

C. *The Inadequacy of a Purely Physical, Physiological, or Chemical Approach*

A very serious danger to the student's understanding of the true nature of psychological phenomena may possibly result, for instance, from a superficial examination of some of the literature on neurology and endocrinology. He may be led uncritically to assume, at times, that man's actions can be adequately explained, for example, by the neurologist and the physiologist, particularly when assisted by the endocrinologist; and that the psychologist, in his dealings with the activities of human beings, is a rather naïve combination of physiologist, neurologist, endocrinologist, and chemist. Robinson remarks in this connection, that the medical student is constantly encouraged to translate his clinical observations into terms of anatomy and physiology. But as he grows older, "the simple world which he saw as a medical student — a world in which an anatomical-physiological organism is responding to an environment of essentially physico-chemical forces — is largely left behind." [1]

a. Disease. Lest such an assumption remain unchallenged, we wish to suggest that the student briefly consider a case taken, for purposes of illustration, from an institution for the criminally insane. He will see before him a raving, screaming, cursing individual who must be very closely guarded to prevent his killing or injuring others as well as himself. Like many others, this is a very striking case. The whole organism is definitely involved. His intention is undoubtedly deadly; and his understanding is impaired. It seems quite logical in this extreme case to assume

[1] *Man*, p. 45.

that his nervous system must be seriously diseased, his various glands must be disordered, his muscles must be improperly adjusted, and his habits must be bad in order to produce such forms of behavior. Yet this, apparently, is the truth: A most searching examination of the muscles, blood, lymph, glandular secretions, and various organic waste materials produced by such an individual fails completely to reveal a single agency at which the finger of causation may be definitely pointed. Nor do the most careful post-mortem analyses of the brain and the spinal cord show any *structural* change which might serve as the possible bodily *basis* of a significant causal factor. We are reminded, in this connection, of a statement made by Lashley while discussing the relation of the maze-learning activities of the white rat to its brain structure and function. "How functional specificity can exist," he remarks, "without structural is not clear from our present theories of nervous functions" (p. 125).

What is apparently true in a case of a human being of the above sort is essentially true in those other diseased persons who may, for instance, repeat the same action, day after day, in quite the same way regardless of time or place. The delusions, the hallucinations, the hysterical postures, the stereotyped actions, and the fear of normally harmless objects and situations have not been reduced, in the slightest degree, to the descriptive terminology of neurology, physiology, and chemistry. And, while such causal conditions as syphilis, old age, brain tumor, and alcohol unquestionably produce serious physiological disorders, yet again the particular form of functional disturbance must be explained in each case in the same way, *namely*, in the terminology of psychology. Two men, for example, may suffer with syphilis. The one may claim that he has a hundred wives and a thousand children, while the other claims he is being persecuted by the members of a religious order. This *difference* between two individuals in the nature of the relations sustained by them toward environmental objects cannot possibly be referred to the work of the tiny organisms which slowly destroy their brains.

No one, we suggest, has adequately described such phenomena as perception, memory, imagination, understanding, and creative thinking in terms of physics, chemistry, glands, muscles, or the properties of the neural impulse or the synapse. They are unquestionably psychological, although they very definitely involve

the same organism that is treated by the physiologist, the neurologist, and the chemist. They are actually as real, if we *must* raise the term, as any other class of phenomena. They are unique functional properties of man. And they fall within the boundaries of the field of psychology.

b. Choice and Will. Psychological determination of human action appears most clearly in choice and in will. In such, the personal history of an individual plays an extremely important rôle. The ideals, standards, attitudes, preferences, rules, habits, information, and desires commonly involved in these must be regarded as being purely functional products. They exist as a result of the nature of the relations which an individual sustains toward life situations. Choice without previous experience of a fairly definite sort is utterly impossible. There may be much action, it is true, but it will not involve an evaluating, a weighing, and a selecting. The wider the range and the greater the diversity of observed situations, other things being equal, the greater are the possibilities for choice activity. That which limits an individual's opportunities for experience must necessarily restrict his selective actions.

c. Heredity, Training, and Environment. Some human beings are undoubtedly limited in this manner by their heredity — thus nature imposes its strict limitations upon the drooling idiot. Other individuals are definitely restricted by the very nature of their earlier training — thus a man may be marked by an inadequate education. Finally, men's opportunities are inevitably bounded by the narrow confines of their environments — thus they may be so simple that they raise no problem of choice. As we have previously said, most of man's choice-situations are not of his own making. They are forced upon him by conditions over which he may have no control. If his physical and social environment is not complex, and if his history is such that his simple needs are easily satisfied, he may forever remain a stranger to the indecision and the deliberation which characterize choice behavior.

Unfortunately, however, for the maintenance of his equanimity, his peace, and his contentment, the average individual is not equipped by heredity, trained by experience, and placed by environment to meet life in this simple manner. Even though he were, it does not necessarily follow that he would be in a better position to realize his outstanding psychological goal, *namely*, to secure for

himself the *greatest possible amount of happiness.* In closing, we are reminded of Tennyson's poetic conflict and his dream of living the simple life in which he wished for his own happiness —

"To burst all links of habit — there to wander far away,
On from island unto island at the gateways of the day. .
There the passions cramp'd no longer shall have scope and breathing space;
I will take some savage woman, she shall rear my dusky race. .
Fool, again the dream, the fancy! but I *know* my words are wild,
But I count the gray barbarian lower than the Christian child."

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OUTLINE

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CHAPTER XIII

MEMORY

A. *Introduction*

The major task of psychology is concerned with those functional properties of man whereby various objects in the world are observed and treated. It has to do with the description and explanation of the meaningful aspects of life situations. The human organism possesses many unlike functions. Some are psychological and others are not. Those particular functions which serve as means by which objects of the world come to be observed and acted upon by man in terms of their several properties are psychological. The various properties which objects possess solely by virtue of the relations sustained between man's functioning nervous system and sources of energy lying outside it are psychological. Such characteristics, as is true of all types of properties — chemical, physical, psychological — appear only under certain definable conditions; that is, they are definitely caused. They can, therefore, be adequately understood only when properly considered in terms of the determining factors of some total situation. These psychological properties are neither chemical nor physical, yet they may be intimately related to such properties of objects.

We have pointed out that man always deals with objects. It is in no sense a matter of personal choice with him. He has no alternative; he must deal with objects. His lot has always been cast with objects. His course of development as a human stock has threaded its long way among objects. It is, in short, his very nature to deal with objects. He is, however, quite versatile; nature has generously equipped him with unlike ways of trafficking with things. Some of these are, in part, the ways of his subhuman neighbors. Man and animal accordingly perceive objects in terms of such properties as their color, shape, odor, distance, and sound. Moreover, they act toward these objects as a result of their heredity and their personal history in a great many different ways. Per-

ceptual objects are seen, heard, and smelled. They are before and around the individual. The normal individual can act toward them — move toward them, change them, or walk away from them. If a time *dating* were demanded for perception it would be *now* or *present*. But man differs both structurally and functionally from his subhuman neighbors. His long racial development has been definitely marked by the emergence of new functional properties. Man possesses ways of dealing with objects that are either lacking or are relatively unused in the animal. Of these several ways, one is memory.

B. *The Nature of Memory*

Memory is a functional property of man. It is one way of dealing with objects of the world. Man functions in memory to produce situations in which objects possess meaningful properties. Such objects may be either human (himself and others) or non-human. They may show familiarity, shape, color, size, and movement. Or, they may bear only a class meaning, such as animals, automobiles, or parents. In every case, however, some form of object is observed. The student can confirm this fact by regarding his own memorial references.

a. Time. The observable meanings in memory, then, are not strange or peculiar. They have to do with one or more of the psychological properties of things. Such object meanings represent forms of functional products. Although certain properties of memorial objects are like those to be found, for example, in perceived objects, others are different. One such property has to do with time. In memory, among normal individuals, a time meaning appears in many cases. This reference points to a previously observed situation. Memorial products always bear the unmistakable *stamp* of an individual's history. Its dating may be very exact; or, it may fall within a span of several years. But it is always personal. We do not say that this time property must necessarily be observed in every case of memory. It appears, however, if an individual is definitely instructed to observe it. In many cases, when one is not *describing* for the benefit of another, such dating may not be present. In memory, one may again walk and talk, work and play with a friend or loved one who has long since died. Or, one may flee in memory from a vicious animal belonging to one's childhood or youth. This sort of thing appears to a striking

degree in certain forms of functional diseases. In such cases, the individual, psychologically viewed, may move around — live — as he did years ago. Certain scenes from his past may be reënacted time after time. The normal individual, however, is able to observe this time reference. This discrimination undoubtedly marks a most outstanding difference between normal and abnormal individuals as far as their memories are concerned. The loss of time dating may thus have very serious consequences for the individual.

b. Place. Memory, moreover, involves place property. There are particular spatial relations. That is, some simple or complex situation is observable. One remembers an object as seen on the street, in the woods, or by a water-fall. I distinctly remember Theodore Roosevelt as he stood smiling broadly and waving to a crowd from the rear platform of a slowly moving train in Kansas. Thus place meaning seems normally to characterize the many unlike objects produced through memory. There are, however, many objects which are observable from time to time and which some students occasionally confuse with memorial objects. In some forms of reverie, for example, objects may move in succession before an individual. But they do not fit into any particular place or time series. They are not to be confused with memorial objects.

C. *Its Relation to Perception*

a. Likeness. We have sought to make clear that perception, regarded as a psychological function, involves a number of unlike ways of dealing with objects which are present in the environment of the organism. Objects are observed in terms of their various properties. This observation is perception. Memory, likewise, should be regarded as including a number of ways in which objects may be observed. There is, then, no one memory. When any object or situation is observed as belonging to one's past, there is memory. Uncritical students sometimes assume that memory, in some strange manner, is more *mental* than perception. They seemingly believe that man is able through perception to deal with *real* objects while through memory he can deal "only with *mental* objects." A careful consideration of the actual status in each case will reveal, however, that the objects in the one case are no more real (more or less mental) than they are in other cases. The

objects in both cases are really psychological, that is, their observable properties — what one knows about and acts toward — are psychological. For instance, when one remembers his mother or his father, the remembering does not make them *mental.* This can no more be true than his perceiving them can possibly make them *physical.* Through his perception, certain properties are observed in his parents. Similarly, in memory certain properties are observed in them; or, in other words, they are observed in terms of certain properties. The remembered *characteristics* of an individual who has died may be very different, indeed, from what the memorial properties of the same individual would have been if he had lived. We perceive certain properties in one who is living. We also remember certain properties in one who is dead. A fundamental point may possibly be made here. For example, in my memories of a boyhood associate who was killed while on a hunting trip with me, I do not find such characteristics of size and shape as are common to full manhood. Although he has long been dead, yet I observe him, at times, in memory as he was then — not as he might have been if he had lived. My youthful associate, then, is in no sense a *mental* individual. He is actually no more mental than any one of my *living* associates of whom I have many memories. The student must distinguish between psychology and physics.

Memory, therefore, is intimately related to perception. The meanings of the former are dependent in part upon those of the latter. Objects which have earlier been produced in perception may also be produced in memory. Memorial products are perceptual products with some properties subtracted and some properties added. Time properties, for instance, are quite different. But perception, in turn, may be dependent in part upon memory. That is, memorial products may determine, in part, the nature of what man perceives in a particular situation. Thus memory may serve to instruct an individual so that he perceives objects which would otherwise have been disregarded. When an individual returns, for instance, to a place previously visited, the memory of a particular feature of it may lead directly to its perceptual observation. The situation now is not as neutral as it was upon earlier occasions. Memory in such cases actually serves to guide and determine in part the objects of perception.

b. Difference. While perception and memory are alike in that they both deal with certain psychological properties of a situation, they are also quite different. In addition to the time meaning (dating), other significant differences between them appear both in terms of their nature and of their causation. In general, more properties may appear in a perceptual object than in a memorial object. Man, generally speaking, is able to perceive much more than he is able to remember. Moreover, various properties are more easily figured in perception. For example, such properties as color, sound, or taste may not be so striking in an object of memory. A memorial situation, too, may not show as many different kinds of objects (diversity) as a perceptual situation does. These various differences are due to several factors. Memory, for instance, deals with a particular object or situation out of an individual's past. His perception originally produced a limited number of object properties which now furnish the basis for his memory. Of the total number, only a few may be remembered because many perceptual features may have appeared under a very momentary situational set, such as might be involved in avoiding a collision with various persons during a stroll down the street. We forget a great many unimportant meanings. When a particular object clearly emerges, however, to assume significance, it may be reproduced readily in memory. Furthermore, an individual while perceiving may *change* his intention or set or instruction, if given sufficient time, and thereby increase the number of perceived features or characteristics. In memory, however, such changes are relatively less important because the total range of objects has already been fixed. Even here, however, instruction by self or others may serve to bring out many additional features.

c. An Illustration. If I am leaving home I may see only my mother standing in the doorway. I may not see many other possible features of the situation. There is, accordingly, no memory of these. But if I were to stop and carefully observe additional features of the situation, I should be laying the functional foundation for a more extensive and detailed memorial situation. At times, when man has come to some last view, he may go over the perceptual situation in such detail that subsequent memories of it are actually much richer. At these times, there may be the definite *intention*, as he goes over the situation, to fix it

permanently. Thus again we deal with the significance of instruction — of preparation — for later functioning. Where other things are equal, the particular form of instruction under which man perceives determines the nature of his memories. Moreover, in memory, individuals deal to a considerable degree with a total object (or class) meaning. In the above illustration, for example, it is my *mother*. Now, it must be understood that if there is nothing unusual about her dress, her posture, or her actions to instruct me, I may most likely have no memory of them. But I do remember *her*. The student should clearly realize that this class meaning may possibly account *in large measure* for certain aspects of his memories. He may walk down the street, for example, and pause at the crossing to *wait* for an approaching vehicle to pass. He may possibly remember very clearly its passing, but he may be totally unable to remember its "make," whether it was a truck or a passenger car, or many other features. However, if it were to be monstrous or tiny in size, or if it were to be unusual in shape (like the strange English racing car that has been driven so fast), he will most likely remember such properties for many years. Under these conditions, closer observation has not only been given to the object but it has been definitely removed from a *general* class.

Perceptual properties also depend in part upon the operation of some form of physical or chemical energy (stimulus) upon the nervous system (sense-organs). As long as the functioning organism maintains a fixed position toward a particular source of energy, certain object properties tend to persist. When the organism changes its position, the object may either change or disappear. Perceptual objects, therefore, normally bear a definite spatial relation to the organism. Turning the head 90°, for example, may cause a visually perceived object to disappear. But a memorial object may be observed with the eyes closed, or in complete darkness, or with the head held in any position. At times, regardless of the energy relations of the environment, a memorial object may appear and completely dominate all other functional products both outside and inside the organism. As we shall later show, the causal conditions are different in the two cases. Causation differs in part, the functional *mode* differs in part, and the object produced differs in part. But in each case — causation, mode, and object — there are common features.

D. *Its Relation to Action*

The properties of memorial objects are functional products of the human organism. They are meaningful characteristics of life situations. They may be regarded, if we may so speak of a unitary function, as being the *end-stage* of one form of psychological activity. It should be understood that an individual may possibly remember many objects without having any objective other than the sheer satisfaction that may be directly derived from considering them in this way. We find here essentially the same condition as exists in perception where one may perceive for the sheer pleasure that it brings him. In many other cases, however, the instruction or intention (need) is quite different. The individual *remembers* some property or properties of an object; he then acts in a more or less specific manner toward it. He leaves his office, for example, carrying a book. At a later time, he perceives that it is missing. He then endeavors through memory to secure exact *knowledge* or information concerning it. What he really seeks in this case, of course, is the *place* or *locality meaning* of the object in order that he may proceed toward it. He may possibly start moving back over his course seeking (looking) here and there. But upon remembering that the book was left in the street-car his actions may become directive and purposeful. Or, perhaps, upon remembering that he left it in his friend's office he turns and goes on his way.

Memory and action, then, are intimately related. They are both functional properties of the *organism* which involve the central nervous system. They are different psychological ways in which the human organism works. They are cut out of the same piece of cloth. The one (memory) is no more and no less psychological than the other (action). The products of former function unquestionably serve at times to initiate the latter. These two functions may form a highly integrated pattern. What is true, as we have said, of perception and action in this respect also holds true of memory and action. We do not assume that man remembers with one part of his brain and acts purposefully with another part. The whole brain produces an object in memory. The same brain may then continue to function and produce certain actions with respect to the object of memory. Whether action follows depends entirely upon the nature of the situation (upon the instruction). In either case, as we understand this matter,

the particular observable behavior pattern represents but one side of the total functional pattern. There can be no action, as in this particular instance, without the proper guidance of memory. The memory side merely serves to produce a particular kind of situation which may possibly be resolved by the individual's acting in some manner toward it. Both memory and action stand, then, as functional means of achieving satisfaction — or reaching some desired end. The rôle of memory in this respect is most clearly shown in those cases where action is either delayed or completely thwarted by a failure of memory. The individual often finds himself baffled. Only the observation through memory of a situational meaning may release the organism for further action.

E. *Learning and Memory*[1]

Students at times regard memory and learning as being identical. They often say, for instance, that a poem has been memorized. Or, a set of dates is to be memorized. They would not say, of course, that they *memorized* the various conditions of an automobile accident in which they were injured, or the various events occurring upon the occasion of their leaving home to come to school. It would indeed have sounded a bit strange, to cite an illustration, if Charles Lindbergh, for example, had testified that "I *learned*" — instead of "I remember" — that I took my rifle and ran out of the house in search of the kidnapers. Let the student regard any particular event in which he has been directly involved and about which he himself has direct personal knowledge. Of many such situations, the individual will undoubtedly say "I remember."

a. The Distinction. We do not wish to be guilty of trying to draw meaningless distinctions. But there are worthwhile reasons for separating memory and learning. We wish to refer to some of these. As we shall later show, certain types of therapeutic measures which are valuable in dealing with certain forms of psychological or functional disturbances depend upon memorial revival. These methods seek to aid or cure a disturbed individual by assisting him to remember certain critical situations which he has earlier faced. Memory, in such cases, appears to be a necessary step to relief. Again, in giving evidence in the court room much

[1] Some psychologists speak of observational memory and rote memory. Under rote memory, to be considered in a separate chapter, we shall include the nature and problems of learning.

use is made of memories of scenes which the witness previously observed. Court procedure would have to be greatly altered if man's memories of particular situations were not permitted. But there is another reason of a different nature. As long as an individual holds strictly to science's most valuable and indispensable method, *namely*, observation, he can safely draw a significant distinction here; he can classify certain phenomena in terms of memory and of learning. The methodology of therapeutics, of law, and of science thus sanctions the distinction which we attempt here.

b. Likenesses and Differences. Memory and learning show likenesses and differences. In as far as both concern that which has occurred in an individual's past, they are unquestionably alike. The fact that both are recognizably related to the same general period of life has often caused them to be confused. Both concern the personal history of man. Both also have to do with the past affecting the present. But the one has to do with that which is directly observed, while the other concerns that which is either inferred or assumed. Such a distinction appears to demand recognition. Generally speaking, we may say that memorial reference is backward to a particular past event. It refers to a definite part of an individual's own personal history. But the matter of learning is different. Although it may be quite difficult or impossible to show that it really does belong, it must always be regarded as being a part or phase of the personal history of an individual. For purposes of understanding, let the student consider such matters as *instinct*, *racial differences*, *general intelligence*, and *high achievement*. Let him question: How much of *each* of these is actually learned? When he has answered this question, let him consider that some men have definitely held that many if not all the characteristics which fall under these several headings are learned. Watson, for example, has said in part that if he were given a hundred bits of protoplasm — called babies — he could make them into any desired type, *namely*, doctors, lawyers, and the like. He accordingly regards the significant differences to be found between races (pigmy and Caucasian) as being acquired. But many men have been unable to find any scientific justification for such claims. They accordingly reject such an approach as being inadequate. Such inadequacy is most obvious at the subhuman level where learning, if it were to account for the many

behavior patterns which appear within a few hours after birth, would have to proceed at an astounding rate.

c. Distinction between One's Past and His Memory. The most intelligent individual may show a great many forms of activity which he has good reason to believe have been learned. But unless he has been informed by some observer, he may have no knowledge or understanding whatsoever concerning their origin. The normal human being unquestionably perceives and acts in various ways as *one result* of his past. This we shall call learning. But it is quite different from memory, as we use the term here. As a striking illustration of this historical difference, we wish to suggest to the normal student that *as far as he himself knows*, he got out of bed the very moment after he was born and casually remarked to his physician that the temperature conditions of the room did not suit him! We wish the student clearly to observe, for example, that he speaks and acts today in thousands of unlike ways and at the same time we wish him to understand that each of these many patterns unquestionably *reaches back into his own personal history*. But he certainly does not observe this particular dependence of his present activity upon his past. He does not know, for instance, when he started to speak or to walk. As far as he knows, he has *always been doing* these things — even from birth. An individual's past determines, in part, everything that he does. It is to be regarded as a factor of tremendous importance in understanding human behavior. The permanent functional *changes* which gradually appear in an individual as a *direct result of previous* functioning under instruction and which continually serve as causal agents or factors of future functioning should be regarded as being learned. On the other hand, the production of an observable situation which bears an inseparable, direct reference (time and place meanings) to his personal history is memory. We wish to point out, moreover, that that which is learned best — and which is most useful under certain conditions to the organism — may have the least reference to the past. It has become such an intimate feature of the functional pattern of life that it no longer possesses any particularized — time and place — reference. It may be remarked, in this connection, that we commonly urge individuals who wish to develop a large vocabulary to read extensively and to forget the particular occasions. Words may greatly extend their usefulness, when these particularized meanings

have been sheared away. This leads us to another difference between memory and learning. It has to do with repetition.

d. The Matter of Repetition. Memorial reference is generally most exact when one particular situation has been perceived. Let the student consider his memorial situations. He will discover that the most faithful of them concern just one situation or incident. Memorial ambiguity and uncertainty feed upon repetition. Time thus brings changes in things. A remembered situation may accordingly assume properties common to two or more different perceptual situations. Under such conditions, confusion commonly results — at least in the dating. Repetition, then, is destructive to memory. But in ordinary learning, however, this dating is commonly absent. When a particular situation remains otherwise unchanged, repetition indirectly contributes to greater reliability and exactness. Learned patterns feed upon repetition. We assume, other things equal, that repetition permits the acquisition of a larger pattern and at the same time insures a greater degree of effective integration. Again, we know that experimentation upon a phenomenon commonly demands repetition to insure exactness concerning some one phase as well as comprehensiveness upon other possible phases. Here, as elsewhere, repetition contributes to greater learning (discovery). Lacking learning, life would, indeed, be extremely difficult. The same is true of memory. But the one cannot be reduced to the other. One may actually appear without the other, which we assume to be true, at times, among subhuman forms.

e. Other Features. Of two other differences between learning and memory, the one will be better understood, perhaps, if we will simply recognize forms of advice usually given in order to increase *effective* learning. The learning task is usually spaced at proper time intervals, and various systems of reward and punishment are commonly employed. Neither of these seemingly applies to a significant degree in the case of memory. In the other difference, we find that an individual may very clearly remember the particular situation in which he learned a task, but he may be wholly unable to reproduce the materials which were learned. Or, the learned material may persist; but memory of the particular occasion may be quite lacking. Thus men will repeatedly tell the same stories to their friends. The author now remembers a former occasion in the laboratory in which it was necessary to

learn some materials all of which he has long since forgotten. We shall come to another and striking difference when we consider the general problem of *training or improving man's memory.* We shall point out, at that time, the man's memory may be improved through proper breeding but not through training.

f. An Illustration: Helen Keller and the Matter of Plagiarism. Before leaving this particular phase of our discussion, we wish to cite an illustration which should contribute to the student's understanding. Men often speak loosely of anything which has occurred earlier in an individual's past and which has an effect upon his later activities as being memory. Although we recognize that man's *past* always operates to determine in part his psychological activities, we are unwilling to throw all such factors indiscriminatingly together under one heading. As a direct result of personal history, an individual may do things *which would never have been done* if there had been meaningful references of memory. Helen Keller, for instance, has written of losing some of her dearest friends in a rather unusual manner. Among her earlier stories was one that dealt with the winter-phantasy. Because of this story, she was subsequently accused of plagiarism. She was greatly disturbed by this accusation, but strongly denied ever having read anything similar to the story which she had written. She was unquestionably honest in her assertion. But it was shown that not long after she had been taught to converse, her teacher had read her many stories, including one of winter which greatly delighted the blind and deaf child. Later she wrote the story that brought her much suffering, adverse criticism, and the loss of certain friendships. An intelligent grasp of the truth as we have sought to point out here and a recognition of honesty would possibly have made this trouble unnecessary and prevented much unhappiness.

F. *Recognition and Memory*

There is one property of observed objects or situations which we have previously mentioned. This property of familiarity which emerges under certain conditions is a direct product of an organism's personal history.[1] It is a characteristic of things which man may observe from time to time because of his past. In familiarity,

[1] An interesting case of subhuman recognition is reported by a lion tamer (Nelson). As Tarzan, he wore a black wig and a heavy coat of tan. He had previously worked with this particular lion, but not in this costume. The lion

he may discover that an object possesses a particular class or group meaning. Most environmental objects, of course, possess this particular property of belonging to a class or group. Now, we usually say that "we know" a thing when we recognize it. We may accordingly recognize a plant or an animal although we may never have seen the particular object before. We must, however, have seen those particular properties which it possesses in common with other objects and by virtue of which we are enabled to give it reference. In recognition, we simply place an object properly with respect to other things. Simply stated, we give a particular kind of meaning to it, *namely*, a class meaning. The class meaning may be merely my friend, or my colleague.

a. The Property of Familiarity. If the student will closely examine his various recognitory references he will find at times that they can be *verbally* described in such fashion as this: That is an oak tree, There is the wife of our banker, My good friend, That is John's book, There is my enemy, That fellow comes from my home town (it is a home-town boy), There is the car that turned over yesterday, This is your hat, I know what it is — it is a Dutch harmonica. At other times, he will find that a thing which he observes has the meaning "I have observed (seen, heard, smelled) this before." In every case, this particular property is both unique and wholly irreducible. It cannot be described in non-familiar terms. It may appear as instantly — immediately — as any other psychological property. It may be observed while many other possible properties (of objects) remain unobserved. Mrs. Franklin Roosevelt, for instance, was recently reported as saying that she could not state the color of the dress which her daughter wore on her wedding day. It is actually possible that a melody or a human face observed for the first time may be quite familiar. At times, we cannot say "why" or "how"; "*it just is familiar.*" We may possibly be able at a later time to point out that the melody or face was similar to some other known object. But this does not change the uniqueness and the immediacy of the recognitory property.

b. Familiarity Is Immediate and Independent. The objects of memory possess this familiarity characteristic, if we are set to

came dashing at him "with tail lashing over her back." Recognition came when she was less than five feet away. She suddenly stopped, looked at him, and then slunk into the brush.

observe it. Objects which are remembered and objects which are perceived often have this common property. Perception may possibly bear the imprint of man's past upon it. His memory unquestionably does. Perception passes, in part, into memory by way of recognition. If we carefully regard man in terms of his individual development, we may discover that he perceives objects as being familiar before he shows any indication of memorial dating and memorial placing. The simplest assumption here is that the child observes familiarity in much the same manner that an animal does. It is seemingly independent of all verbalization and reasoning. We do not assume, moreover, that the young child, for instance, must necessarily observe the color of its mother's eyes or her skin or the shape of her nose before recognition appears. We cannot well ascribe such observations to the child when they do not necessarily occur in the adult. The child, we assume, simply recognizes an object. And as long as another property does not appear and *dominate* the object, such recognition will continue. But if the mother should put on a brightly colored dress, or if she should greatly change the color of her face so that either becomes *observed in itself*, recognition may momentarily disappear. We often remark to an acquaintance that he "looks different" or that he was not recognized, although we may be wholly unable to describe precisely the nature of any change, aside from that of recognition. Or, we may possibly say that "I didn't recognize you in that uniform or with that hat or without your mustache." In the light of the various types of recognitory meanings, all which come under the general head of familiarity, we can say that recognition seems always to involve some total object-meaning. Any outstanding change in any non-recognitory property of this object may possibly affect recognition. Here again, we discover the dependence of one psychological property upon another.

c. Kinds of Recognition. It has been suggested that recognition may be grossly divided into two classes in terms of the ways — the conditions — under which the meaning of familiarity appears. It is known that it may come as directly and as immediately as any other psychological property such as size, shape, or color. Thus a man may instantly recognize his son, his friend, or his wife. Of this particular point, Pillsbury remarks in part that when recognition is immediate, one *knows at once* that the object is familiar but there is no evidence of the nature of the process. The thing is

simply accepted. There are no intermediate factors which may be cited to explain it. "One knows nothing of how a close friend is recognized, or of how one tells one's own text-book from one's neighbor's." Titchener, too, has pointed out that careful observers will often report in experimental studies that a particular object has been seen before, "without being able to find anything whatsoever, in the way of verbal idea or kinaesthetic quiver or organic thrill," that might possibly carry the observed meaning of familiarity. We suggest, therefore, that an *object* itself may possess a recognitory meaning. A slight change, however, in other psychological characteristics of the object may accordingly destroy recognition. This is direct or immediate recognition.

Experimental results show in part that where other observable properties of objects occur with the recognitory properties, the former vary greatly.[1] Brown reports a study in which pictures of men and women were closely examined before being mixed with other unexamined pictures. Each picture was then observed in the attempt to discover the basis of recognition. Wide variation appeared. For example, decorations and clothing were referred to in the recognition of 46 pictures of men and 102 pictures of women. On the other hand, facial expression was reported for 82 pictures of men and for only 40 of women. The observer in this case (female) tended to relate recognition to various features of dress in women and of face in men. Other studies show, for instance, that the recognition of ordinary ink-blot objects which have previously been seen may come quite immediately; but it is not quite as certain as in case of human beings. The correlation between ink-blot recognition on the one hand and of recognition of pictures of objects which are given class properties on the other hand is slightly above 0.50.

An object may possibly be recognized only at the moment that it fits into a total situation. This is particularly true where some object has always been regarded as belonging to a particular situation or where it has formed an integral part of a total situation. Men often fail to recognize certain objects which have been transplanted from a particular situation to a wholly different one. As a matter of fact, we may possibly fail at first glance to recognize an

[1] We take the following from *Inside the Cup:* "For months following his experience, particular smells, the sight of a gasoline station, or a certain popular tune gave him a short twinge of pain" (Churchill).

individual from our home town upon meeting him under very unexpected or unusual conditions. We may fail to recognize a dog except when seen with its master. We may accordingly fail to recognize certain landmarks in the city or in the country when we approach in such a way as to perceive them as constituting a totally different situation. This recognition of an object is sometimes called indirect recognition. The distinction is drawn, of course, in terms of conditions and *not* of meaning. Regardless of the particular conditions under which the recognitory property appears it does not emerge in any piece-meal manner. Moreover, it is either present or absent. It comes at once — to stand as a particular characteristic meaning or property of an object.

G. *Paramnesia*

There is a condition which appears at times and which is commonly known as "paramnesia." It simply denotes the presence of familiarity in a situation which "should" be strange. That is, the observer lacks supporting evidence or knowledge through memory that the particular situation which he now finds to be familiar ever occurred previously. Every individual has no doubt observed this property of familiarity. He may, for example, have been dealt a certain hand of cards. As he glanced over them he may suddenly have observed the meaning that he has held this hand under precisely similar circumstances. Again, he may have been talking to an individual. Suddenly he observed the meaning that "I have done this very thing before." Many illustrations of this sort occur in the literature of prose and poetry. It has even stood as the observational basis of a belief in the transmigration of souls. It may form a mystic bond in the association of two individuals. This is more true, since this meaning may possibly appear more often when the individual is emotional or otherwise disturbed functionally (embarrassment, uncertainty).

Such meanings may also arise where a particular situation is observed at one particular moment and then again at a later moment. During the intervening time, however, some "disrupting" factor enters. As a direct result, memory of the previous observation is *lacking*. But there is a very definite carry-over from the past in the form of recognition. The situation is now familiar; it has been faced before; but at what time, the individual is quite unable to state. Two successive observations of one

common situation which lack the integration normally given through memory may stand in such cases as the psychological basis of paramnesia. The property of familiarity itself is not peculiar or strange in such cases. But the absence of a memorial meaning thus gives rise to a kind of property isolation that seems strange. It cannot be understood; it is mysterious.

There is another possibility that the meaning of familiarity may arise in part as a direct result of the presence of a non-familiar property (or properties) *common* to two different objects or situations. This property may not be observed, however, since familiarity itself is so outstanding, and since the particular arrangement of the various features which are observed may persist only for a brief moment. We may definitely know that a face appears familiar to us; but we may be unable at the moment to offer any explanation. If we have sufficient time as well as inclination to make a careful examination, we may possibly discover either some one feature or some total arrangement of features which we may assume to serve to relate two individuals — one of whom is a friend and the other a stranger. Two objects, quite different in many respects, may become related psychologically through familiarity. This relationship may serve as the psychological basis of paramnesia.

II. *Significance of Memory*

The above paragraphs should shed light upon one significant feature of memories. They tend to show that memory contributes continuity to the other psychological activities of the organism. It furnishes an integrative link which serves, in part, to bind past and present into a single functioning pattern. In this sense, it may be roughly compared with the nervous system whereby the various structural divisions of the body are intimately related in a functional manner. Through memory, coherence is established in man's life. That which precedes stands intimately related to that which follows. By virtue of such relationship, that which follows assumes significance; it has bearing; it is orderly — not chaotic. Life, then, is not a sequence of events characterized largely by successive but unrelated observations, which can be compared to a series of beads strung together where each is independent of the other. On the contrary, normal life is a pattern in which no part is wholly independent and wholly separable. It is a dynamic process which moves steadily onward, and as it goes it

proceeds to weave its own ties. New properties gradually emerge to characterize and qualify the individual and each in turn contributes to the total pattern. Running through the entire pattern (we include environmental objects here) are the memorial threads which, like the warps of a woven pattern, bind and support it. The profound significance of this continuity is shown in the lives of those organisms in which memory may be either (*a*) lacking or (*b*) disrupted, *namely*, in normal animals where it is largely lacking and in abnormal human beings where it is disrupted.

a. Achievement. Memory determines, in part, great industrial, economical, scientific, and literary achievements. Rote learning which may be represented in the mastery of facts, formulae, and principles is not enough. The scientist, for example, often observes a particular phenomenon in the field or school or laboratory. The memory of it may stay with him. Much later he may set himself the definite task of investigating its nature. Again, poets and other writers often build upon a memory of long standing. Memorial products thus clearly furnish the *basis* for many of the more ordinary affairs as well as the more significant achievements of life.

b. Enjoyment. In his memories of the less significant affairs, man often finds a major source of happiness and personal satisfaction. If memories should serve him in no other way than this, their value to man would be fully justified. There is no experimental means of securing a measure of the extent to which man draws upon the many products of his memory for satisfaction. We know, however, that he is quite prone to day-dream. In such dreams he may at times enjoy companionship which is now denied him. As man's perceptual environment becomes increasingly limited as a contributory source of satisfaction, either directly because of himself or indirectly because of others, he does not become functionally inactive. He usually turns to his memories. Although this is true at all stages of man's life, it is especially true in his old age. In these advanced years when physical disabilities and infirmities stand as unscalable barriers to further perceptual achievement, individuals turn more and more to their memories. Under the increased thwarting with reference to the future, which is so attendant upon this period, comes an increased dependence upon the past. Nature thus furnishes its functional compensations. Lacking such, human life would undoubtedly be unbear-

able. Warren reports cases of remembering which extended over periods as great as seventy-five years. He cites one from his father who during a conversation in his ninetieth year suddenly recalled for the first time an event which had occurred when he was 15.

The wise — and happy — individual, we suggest, is one who approaches old age with a history such as to provide many pleasant memories to sustain him in his declining years. The writer has often been impressed by the fact that some aged individuals appear to be quite happy and self-sustaining, psychologically speaking, during this period, while other individuals are a trial to themselves and to their associates. Life for all concerned would indeed be happier in many cases if every individual were adequately equipped memorially to approach that period in which nature prepares man for the end. While work may provide a part of such functional preparation, the larger amount probably comes from play and from playful associations with others. In a story of his life (*Sat. Eve. Post*, 1935), Vanderlip, for example, remarks, in part, that if he could live his life over he would play and seek the companionship of others more.

c. Troubles. To balance the other side of life's ledger, we frequently find the products of man's memories serving as fertile sources of many troubles. His memory may afflict him both by what is given him and by what is withheld. He remembers the unpleasant as well as the pleasant. In this connection, we must point out the lack of experimental sanction for the common notion that we forget the unpleasant and remember the pleasant. Daily life teaches us that we recognize and remember many unpleasant situations. We often say that "I feel just as bad as I did yesterday," or, "I have the same unpleasant mood." We also know that we have long memories for objects which we hate or dislike. We may have more pleasant memories than unpleasant because we probably have more original experiences of the former type. Studies using pleasant and unpleasant chemical substances as objects have accordingly shown the lack of correlation between pleasant and unpleasant properties and the ease or difficulty with which they are remembered.

Man can produce in memory only what his history and his momentary environment permit. Too frequently for his personal happiness and efficiency, his memorial products disturb his emotions and interfere with his actions. At the simplest level, the

individual may simply worry over a particular memorial product. Or, an object or situation may come again and again in memory to vex the individual despite his every wish and intention. The pattern in such cases is usually visual or auditory. It may be so dominant as to make impossible the observation of other things. To escape from a memorial situation with its attendant disturbance (remorse), individuals not infrequently surrender themselves to drink, drugs, or the law. At times, they seemingly escape only through suicide or some disease. In connection with some forms of the latter, we find an outstanding symptom taking the form of a *lack* or *insufficiency* of memory. Here the individual has forgotten too much; his functional integration is definitely impaired; the present and the past are partly or wholly disjoined. The coherence, the continuity, and the significance common to a normal life are greatly disturbed.

We must understand, however, that large gaps measured in terms of time may exist in an individual's life, yet there is no loss of continuity. Head reports that during an epileptic attack, an individual may move around and do many things. Yet when it has passed, he has no memory of the period — in fact, he may not even know that he suffered an attack. His life is simply resumed where it left off in quite the same manner that it continues after a night's sleep. Finally, memory may furnish the keen edge of what commonly passes for conscience. The latter is undoubtedly more than memory. And there may be memory without conscience as in the case of the young child. But much of man's conscience depends upon his memory. This is implied when we say that our conscience is clear; there are no gnawing memories; we have nothing to regret. We recall here the remorseful description of Kipling's soldier who musing upon the events of a misspent life discovers finally that,

"The worst of it all is just setting and dreaming."

I. *Disturbances of Memory*

We have definitely assumed that, functionally regarded, the *normal* organism is at all times a unit. We find no reason to assume differently. We regard no function as running its course quite independently of other functions of the organism. Independence, of course, is a relative matter; there is *partial* independence. The degree depends upon the situation and the instruction. One can

undoubtedly perceive without memory. And one can remember, at times, without perceiving or acting or being emotional. When functional independence becomes too great, however, abnormality exists. The functional exaggerations and deficiencies of certain abnormal personalities (mild delusion) clearly show how one function may be affected without significantly impairing the organism in other ways. Other types, however, may involve the organism in several ways — perception, action, emotion, and memory. Memory disturbances, for example, are very common in hysteria.

a. Nature of Functional Disturbances. Abnormal individuals show varying degrees of functional disturbances. In every case, we distinguish between memory and learning. Here we are concerned with the former. We do not *assume*, therefore, that individuals learn to be "crazy" or that they become *habitually* diseased. We must think here in terms of function and its impairment just as we do, for instance, in case of many ordinary physiological disturbances. Thus we assume that an interruption may occur in a human being to constitute a psychological disorder in quite the same manner that physiological disorders occur. As a matter of fact, being afraid or worrying, for instance, may interfere greatly with both psychological and physiological functions. Worry may affect the thyroid functions with widespread organic effects. While interruptions may come suddenly, just as a diabetic condition may possibly develop from a great emotional seizure, their effects may linger long. Since they *may* come suddenly, a most detailed consideration of an individual's learning, as we use the term, would give no adequate understanding of many forms of psychological disorders.

During the World War many men suddenly broke down while facing certain situations.[1] They became paralyzed, blind, deaf, or amnesic. No one has maintained, for instance, that one man learned to be paralyzed and another learned to shake so that he was unable to stand or walk or feed himself. Again, the possible assumption that an established habit has been broken has no particular significance when the problem concerns the most effective technique of relieving an individual of his troubles. This is especially true in those cases in which an individual has lost his *memories* concerning the particular occasion under which his

[1] We do not imply that some cases may not have had a long history. We simply suggest that a perfectly "normal" man has his limitations. He can stand so much.

functional impairment has appeared. As we shall later show, the treatment of the individual in such cases does not involve teaching him new things or old things about the situation. As a matter of fact, no other individual may *know* the least thing about the particular situation in which this psychological condition was produced. Many pathological cases appeared where no one knew where a man had been, or where he belongéd (regiment, etc.), or what he had done. At times, such individuals could converse and act normally, yet were lacking those particular memories necessary for the *resumption* of former activities. Their integration — continuity — was impaired.

b. Nature of Memorial Disturbances. We wish to suggest at this point that every change — normal or abnormal — which is induced in an individual as a direct result of some particular environmental situation is not a matter of learning. Many functional changes appear in man as a direct result in part of a particular situation, which are no more learned than a change, for example, in skin color under sunlight or the various functional disabilities which follow over-heating (sun-stroke) are learned. An adequate understanding of many cases of psychological disorders rests, therefore, in part upon a proper evaluation of the significant rôle of memory in ordinary life affairs. The elimination of a few memorial products or references may have very unlike consequences in different individuals. At times, a man who is incapable of remembering a small portion of the situations of his personal past may continue without any serious difficulty. Such losses may appear under either physical or psychological shocks. Thus an individual following a brain injury may lose all memory of a particular situation. Even when all traces of the neural damage have passed, memory may still be lacking. The use of drugs may also produce similar functional impairment. Individuals at times remember nothing of an intoxicated period. Moreover, participating in an emotional situation may have the same psychological effect. The shock in this case is purely functional. No structural impairment of the nervous system of the individual is therefore discoverable, although his psychological integration may be seriously disrupted. We cite an illustration in this connection from the autobiography of Charlie Chaplin. It is drawn from the period of the World War when Chaplin, Marie Dressler, and the Fairbanks were received, as representatives of the motion picture

industry, by Woodrow Wilson. Chaplin[1] reports that as one result of the attendant emotion, he was wholly amnesic for various features or incidents of the interview.

c. **Amnesia.** Amnesia may also reach backward from a given situation to affect remembrance of preceding situations. This is retrograde amnesia. Certain particular features of a time period may thus be affected, while other features may not. Again, every functional product — everything perceived and every action of some earlier period — may be unremembered. The impairment in this case is both general and impartial. Stratton reports upon many individuals who suffered amnesia for all things preceding the great earthquake at San Francisco. The periods varied from a few hours up to days. He also points out cases of hypermnesia in which memorial situations of this same period stood out with startling clarity. In some cases, two kinds of memorial modification were definitely mixed. In anterograde amnesia, however, those functional products which appear during a longer or shorter period *following* some disturbing situation are affected. Here, again, the loss may be either particular or general. It should be understood that amnesic periods may come frequently and last a short time, or they may be more widely separated and, at times, last days or months.

d. **Transposition and Rehearsal.** Certain disturbances which occur in memory sometimes take the form of a transposition in time and in place. The temporal dating may accordingly change to a period before or after the calendar date of an observed event. Some particular situation may change in this manner or a whole period embracing months or years may be moved. The psychology of testimony shows this to be an outstanding type of error. An individual may be quite sure of certain spatial properties of a remembered situation but quite uncertain concerning its temporal properties. Or, he may be quite sure of its temporal properties, although he may be wrong. Another kind of disturbance results from rehearsals. It quite often appears that an individual hears the description of a situation. He may then remember quite clearly the described situation but not the conditions under which he heard it. In such cases, he may actually report the event as a memorial one — as belonging to his own past. In this way, it is possible to understand those individuals, both children and adults,

[1] His *Autobiography*.

who sometimes describe a situation as being memorial although the auditor knows that it is not. When such confusion of temporal properties becomes too frequent, a form of pathological lying probably exists. Some individuals are actually unable, as a result of their functional condition, to date and place properly many of their various sources of knowledge (observation).

J. *Therapeutic Aids to Memory*

Among the several methods employed at times to assist an individual in remembering certain situations, we wish to consider those of psychoanalysis, hypnosis, and association tests. Such methods proceed upon the assumption that objects or situations may actually be remembered under one approach or set of conditions and *not* under another. It is assumed that an individual may be so treated as to cause him to be more productive in memory. Such methods do not pretend, of course, to *improve* an individual's memory in any general sense. Students often assume, since such methods are effective aids at times in abnormal cases, that they will increase normal abilities so that an individual may be lifted to a superior level of memorial achievement. Unfortunately, this is not true. Upon returning to a normal condition, a previously abnormal individual, for example, will not be able to remember *in general* more things and in greater detail. The aid is always specific — not general. It is comparable to helping a physically weak individual over a rough place in the road. His strength is not thereby increased. Or, the type of "improvement" which is really sought under these conditions is essentially similar to that intended by a physician who administers some drug to assist an organism in combating a physical disorder. In each case, the particular method merely aims at bringing an individual to a normal condition. The use of these psychological methods is based upon the assumption that the possibilities of memorial revival are actually greater under proper treatment. By aiding him to remember, they help him in getting well. The road to normality in such cases is the way of memory.

a. Psychoanalysis. This is a method which seeks, by a study of an individual's dreams and conversation, to discover in part the nature of certain features of his personal history. The dreams are assumed to be expressions of repressed wishes and desires, of which some may be cause of the functional disturbance. Less use is

made of these than of the materials produced in conversation. In this method, the individual is definitely encouraged to speak absolutely truthfully about every object that he remembers, imagines, or thinks about. As the individual proceeds, meanings about particular objects or situations may gradually become evident to the psychoanalyst. By using these common threads, he is able at times to assist an individual in reintegrating some pattern, that is, in reëstablishing continuity between past and present. It is true that, when properly used, the method may at times bring relief. This fact stands as evidence of its worth. But we are quite unable, however, to accept any explanation that involves a subconscious or unconscious mind. These changes toward improvement are purely functional. The objects of the individual's world are simply regarded and dealt with in a different way. Various situations characteristic of his past may gradually return. He may talk about things he has not remembered for years. He wanders here and there memorially, and in so doing he is seemingly able at times actually to establish significant relations previously lacking, among various life situations.

It may very well be that many individuals actually require the supporting aid of a situation such as is provided by the psychoanalyst in order to carry out successfully their psychological survey (inventory) of the objects of their memory and imagination. It is quite possible that an individual, by deliberately facing and talking at great length about or around certain topics, may contribute to his integration. It is well known, of course, that in many cases where individuals regard a situation *understandingly*, its possibilities of disturbing them may be greatly lessened. Sensible understanding, therefore, frequently destroys fear or anger in daily life situations. A universally recognized way to freedom from a troublesome situation lies in discussing it in considerable detail with another individual. The latter apparently serves partly to sustain the total flow of meanings and partly to give counsel. Great relief may at times be secured through prayer. In these cases, the prayerful situation seems to sustain the individual in his recital. There may be no counseling in this case; yet the value of prayer cannot sensibly be questioned. A few years ago, an outstanding Protestant minister remarked that many of our churches, in failing to perform their proper functions, were driving afflicted individuals to non-religious sources to secure relief from their troubles. The

psychoanalyst commonly assumes that the individual frees himself of troubles through a revival of an emotional condition which gradually becomes dissipated in the clinic.

b. **Hypnosis.** The nature of situations which have been earlier observed may be discovered at times through the use of hypnosis. This is, perhaps, the most effective method of assisting individuals to remember. It is quite possible for an adult during hypnosis to reach back to an earlier — even childish — period and observe certain situational details. Young [1] speaks of one subject who during hypnosis recovered facts which he could not touch in waking, and of which he could not recognize the truth when told afterward that he had given them in hypnosis. These facts were verified by an older sister. The exact manner in which this is done is not clear; the full nature of hypnosis is not known. But the general character of the functional products which appear during the period of hypnosis clearly indicates that the organism is involved in no strange or mysterious manner. The individual, for example, is able to perceive certain objects and not others; and he can remember certain situations and not others. The period shows characteristics of sleep. Thus bodily activity and certain perceptual properties, including at times those of pain, may be absent. But it differs from normal sleep in that an individual may clearly perceive certain environmental objects. The threshold, in other words, is normally much lower (for some objects) in hypnosis than in sleep. Yet we recognize, of course, that a nurse may perceive the slight movement of her patient or a mother may hear the faint cry of her sick child; yet fail to hear many other things. Some physiological products, moreover, are not affected during hypnosis as they are in sleep; various reflexes accordingly appear in a normal manner.

1. *How It Works.* Since the individual can readily observe during hypnosis, it is possible for the operator [2] to instruct, prepare, or set him to function in a particular way. It is, therefore, possible to affect the individual functionally in many ways. He can be made, depending upon his instruction, to observe certain prop-

[1] Young, P. C., "Functions in Normal Hypnotic States." *Amer. Jour. Psychol.*, *37*.

[2] In some trances and in the autohypnotic periods of Hindoo contemplation, there may be no *rapport*. The degree of control exercised by the operator depends upon the instruction. If the individual is opposed, the operator can do nothing. The operator is often disobeyed.

erties (objects), but disregard others. He is thereby freed to a degree from irrelevant things. Under such conditions, the possibilities for memorial assistance may be considerably increased. The operator suggests to the individual that he remember particular situations. The individual can be led, psychologically speaking, back and forth over some definite time period. In many cases, sufficient memorial references can be produced to reëstablish the individual's life continuity. When his memory has been assisted during hypnosis, the operator can instruct him to remember when he is returned to a non-hypnotic condition. Under such functional preparation, the individual may then be able to discuss *understandingly* the full nature of some previously observed situation and in so doing relieve himself of a troublesome property, especially when it is emotional.

2. *Significance of Previous Functioning.* If we are to understand here, we must recognize that man's past may affect him functionally without his being able to observe the reason. Because of the nature of a life situation, a property (height, distance, color, odor) may become integrated with action or emotion to form a particular pattern. Thus fear, disgust, anger, or loathing may readily emerge in connection with a perceptual situation. The individual will accordingly act or feel in a particular way toward one or more of the perceptual properties of this situation. Such action or feeling often persists long after all memory of the total situation has disappeared. An individual may accordingly show patterns (action and emotion) under certain conditions, although the total situation when regarded by another does not seem to warrant them. Perhaps an analogy would help here. We have said that a normal individual may actually *recognize* objects without the slightest reason for so doing. He may be wholly unable to reduce such recognition to his past or to anything else. Other psychological functions of the individual, we suggest, may be similarly affected. He may accordingly produce very striking patterns — he may become frightened, paralyzed, angry, or just nervous — when there is no observable reason other than the mere perception of a total situation or an object in which a particular property appears. A well-known European statesman has been unable to travel extensively because of his unusual loathing of water, and another man equally well-known in his own field has written a book describing his uncontrollable fear of distance from

his home. Sportsmen know that dogs which have been accidentally shot may readily go any place where no guns may be seen. But the sight of a gun reduces them to a trembling, cowering state. We venture to suggest that such dogs do not know *why* they are afraid. Even the normal adult who becomes very emotional at times may know only that certain objects "upset" him — he simply cannot stand them.

3. *Some Illustrations.* The full pattern of causation, normal as well as abnormal, lies partly within the past. To aid individuals, an understanding must be had of the original situation in which a particular way of functioning occurred. Usually the situation is one in which adequate satisfaction is lacking or discomfort is present. The individual strives to reach some goal or objective (comfort, safety, etc.) but his way is blocked. The soldier vainly seeking protection from the on-coming shell or airplane may be hemmed in or pressed tightly by objects; the child frantically trying to escape from a closet serving as a punishing situation may perceive the smooth hard knob; the partially anaesthetized woman struggling in nausea and pain may see some shiny object — all these, among many others, may point the way to a larger understanding of how psychological properties of objects may stand closely integrated to produce apparently strange relationships. The soldier, or the child, or the woman may later experience varying degrees of discomfort and general restlessness upon sitting closely with others in a car, or upon touching something that is round and hard, or upon seeing something that is *shiny.* But the cause may remain quite obscure. It should be clear, then, that the concept of thwarting (denial) is especially significant in an understanding of many forms of psychological disturbances and losses. Moreover, it should be evident in every case that the individual whose life is disrupted holds the key to these problems. Since they concern his own personal past, the key is memorial. Through hypnosis, for example, it may be possible to open the way to these crucial situations. By facing them, the individual may secure a partial or full measure of relief.

c. Association Tests. Another method of value in securing an understanding of the nature of an individual's past makes use of association tests. In this method a series of words may be given, to each of which an individual replies by giving in turn the first property, or meaning, or object that he thinks about. To *boy,*

he may give the class meaning of *girl;* to *priest,* he may give *good;* to *hate,* he may give *love.* Such tests provide a rather gross measure of normality as such may be determined by comparing the types of objects or properties named by many individuals. The existence of a disturbed condition may be revealed in several ways. Among the various indicators, we find that too frequent report of one type may constitute a deviation from the normal. An individual, we say, may stick very closely to one object or situation; that is, the same meaning occurs repeatedly. He cannot produce any other thing. Such deviations are possibly pathological. But other variations which occur in the nature of the things reported in such tests may also be due to the possession of a history which is decidedly different from all other individuals composing the experimental group; these are not pathological. Among other conditions, that of being a member of a different race, or that of being reared in a foreign country might account for many dissimilarities. Age is also a factor. Children, accordingly, report fewer common associations than do adults (see Fig. 81). In either case, however, knowledge may be obtained in this way about an individual's past.

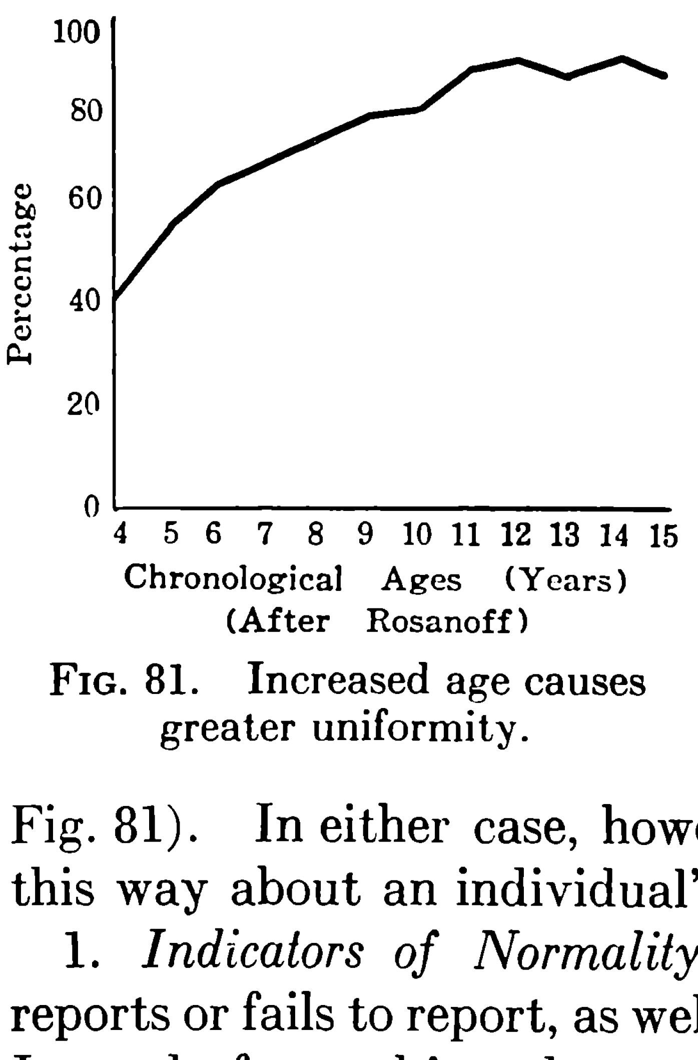

FIG. 81. Increased age causes greater uniformity.

1. *Indicators of Normality.* The things which an individual reports or fails to report, as well as "how" he reports are significant. Instead of one object, he may give several. Again, he may give nothing. He may find himself momentarily or permanently blocked. To give either too much or too little may be significant because of a troublesome period in his past. Or, he may stammer or possibly repeat after the experimenter. From a careful examination of an individual in this manner, it may become evident that disturbing periods appear from time to time and it may then be possible to secure an understanding of them. These methods are based upon the common assumption that the emotional effects of previous situations may linger in an individual's life and at times disturb him although he may normally have no memory of them. The lack of memory is a causal factor in his trouble. Such emo-

tional effects may be removed at times by assisting an individual to remember.

2. *The Nature of Control.* Although we commonly speak of "free" association, we recognize, of course, that there is always control. To deny control is really to deny causation. The term "free," when used in this particular way, applies largely to the particular type of instruction. We may say to an individual, "Name an object of the opposite class"; or we may say to him, "Name the first thing that you think of." Each of these instructions determines and controls in part a particular product. No individual is actually "free" to think of "anything." Associations tests show that persons from a general cultural level tend to think of the same thing when given a particular instruction. That they do this is significant. We can do no better than to realize that man is an organism with a particular past, and his past in part determines the nature of his functional products. In this respect, certain features of his past are unquestionably more significant than others. Their significance may be determined by the influence which they exert upon his manner of functioning. Since man always functions, the flow of object meanings goes on continually and irresistibly. Some things are perceived, certain are remembered or imagined, and others are understood or thought about. Every normal individual recognizes this ceaseless procession. He also recognizes that the stream may show eddies. Certain meanings come back again and again; the individual "thinks in a circle." The normal person, however, preserves a sequence which is fairly orderly. But the order certainly is not entirely of his own making. In so far as he is able effectively to instruct himself, he can partially order this flow. But every individual knows the impossibility of maintaining this orderly relationship at all times. Certain meanings accordingly appear without discoverable relation to other properties. The things are observed; but their integration is not. Particular events of his past at times definitely force references upon the individual without his being able to stop them. Most of us do not deliberately punish ourselves by remembering unhappy things. Where some situation has been unusually satisfying or has been characterized by strong emotions, it may come again and again to disrupt man's waking life and to disturb his dreaming. He is not free.[1]

[1] Free association time is larger than controlled. If free runs around two seconds, controlled will be slightly above one second.

K. *Explanation*

a. Training of Memory. The student's understanding of the nature of memory may be further increased, we suggest, by a consideration of the problem of memory training. It is evident that the ability to produce memorial situations is an inherent functional property of man. It is, in this sense, essentially like various forms of perception. We must accordingly assume either that such properties as perception and memory are essentially inherent or that a vast amount of unique acquisition or development of ability occurs during the first few years of life and then *abruptly stops.* The results of careful studies show that among various other performances, three- to five-year-old children will perceive objects tactually, match lines of unlike length visually, localize objects auditorially, and discriminate weights kinaesthetically equally *as well as adults.* According to Seashore, the auditory limits (pitch discrimination) are definitely fixed by the end of the first year of life. A great deal of experimental data shows quite clearly that certain abilities of man are fixed relatively early. But the particular type of material with which man deals is clearly a matter of *his environment, his needs, his preparation and instruction.* Human beings, strictly speaking, do not continue to improve through the years up to middle or late life. We do not suggest, of course, that an individual cannot change his way of *acting* with respect to certain objects and needs and so improve himself morally or industrially or socially. Such changes, which may number in the many thousands, simply fit into recognized systems of relationships — moral, industrial and social. A brief consideration of the large number of changes which definitely characterize the course of an individual's life without significantly increasing his intelligence will, we believe, sharpen the student's understanding of our point.

There is no legitimate reason to assume that human beings gradually learn to remember and that constant training and practice result in steady improvement through adolescence into maturity. The functional limits are presumably determined through the ordinary processes of biological growth. Such limits may be affected by various factors such as disease, injury, drugs, and old age. But use, practice, or repetition does not permanently change them — no more than *responding many times in the reaction experi-*

ment will gradually increase the speed or the rate of functioning.[1] It is impossible, for instance, to train a feeble-minded individual so that his ability to remember the objects and events of his ordinary life situations will be significantly increased. If it could be done, it undoubtedly would. Such persons, to make our point clear, are not qualitatively or peculiarly different from perfectly normal individuals. The former can remember a little; the latter can remember much more. In either case, changes may occur and persist for varying periods in nature of the objects remembered just as we have seen that it does in perception. These changes in functional output depend upon intention, purpose, or instruction. A man may have failed, for example, to remember various individuals. He goes into politics and wishes to do so. He may now become very good at this sort of thing. But it is realized there has been no general increase in his memorial capacities. While he may be observing the faces of the men present in a group with the intention of remembering them, he is unquestionably missing other things which to him are less important.

An analogy drawn from learning may possibly be significant in this connection. One group of individuals, for instance, was asked to practice learning ordinary numerals. This group was then found to be more proficient than another (similar) group which had had no such practice. At the end of five months, however, without further practice both groups were alike. The previous gain had disappeared. Both groups were then given equal training over a period of three weeks. An examination now revealed that both groups were still alike. The earlier gain had been lost; it has given no permanent advantage. The first — practiced — group had not been improved. Perhaps it would be helpful to note the position of other students upon this problem. Woodworth, for example, remarks in part that it is difficult to imagine how to train *recognition;* moreover, *recall* is rather unmanageable; and, finally, he asks, since retention is a resting state how can we possibly go to work to improve it? Of this same general problem, Pillsbury holds that any improvement of memory is due to improvement in ways of attending, to forming good habits of repetition, and to increasing confidence.

[1] We disregard the slight change that immediately appears and which is presumably due to familiarization with experimental conditions. Strangeness serves as a distractive agent.

b. The Rôle of Intention, Purpose, and Instruction. Since memorial objects are objects which have been perceived, the nature of perception is a major determining factor of the former. Where an individual perceives a particular situation with the deliberate intention of remembering certain features of it, the fidelity of a later report upon these items is definitely enhanced. The first step in memorial production is thus actually taken during perception. Lacking this preparation, an object may be observed but shortly forgotten. The memorial intention itself definitely causes the individual to perceive with a particular purpose; the present situation bears a specific reference. Certain properties or objects accordingly become more dominant — they are memorially figured. They emerge from the ground with a *forward reaching* meaning. The individual who realizes that he will later be held for a recital of what he saw on his trip to the city therefore observes somewhat differently from the way he otherwise would. He prepares himself at the time of observation for what he is to do when he returns. There is a rather simple experimental way of studying this general matter. For example, a picture of a number of different objects may be shown to a group of individuals without anything more than a casual introduction. A few minutes later they are asked to describe the various objects. Another picture may now be shown to the same group (or the same picture may be shown to another group) with the definite instruction that each person will be held strictly for an accurate description at a later time. Very significant differences in memorial report appear in the two cases. The latter is much more efficient. Such differences are to be referred, of course, to the nature of instruction — not to sudden increases in memorial ability or capacity. If the pictures are such as to assume an emotional or familiar character, the results are again different. They now serve (themselves) to *instruct* the individual. This is true even in case of so-called non-sense materials. Certain of these may stand out clearly when they touch upon a known object (*Zev*, for instance, happened to apply to a horse owned by a student who served in an experiment for the writer).

1. *Experimental Studies.* Some instructive experiments have been performed upon memory for things which have been observed but one time. Such studies throw considerable light upon the problem of testimony. Individuals may be shown various objects or pictures (see Fig. 82). They may be asked merely to describe

what they saw or they may be carefully questioned. The type of question has considerable influence upon the memorial product. Four common types of questions are the disjunctive, the expectative, the determinative, and the implicative. They may be illustrated in this manner: Disjunctive — Is or is not the door closed?; Expectative — The door is closed, isn't it?; Determinative — Is the door closed?; and, Implicative — Is the door

FIG. 82. How much can you observe in a short time? Aussage methods make use of pictures.

partly or wholly closed? The last, being strongly suggestive, is most likely to cause considerable confusion. In one study, adults and children were briefly shown pictures after which they were tested for memory at three periods, *namely*, at 5, at 15, and 45 days. The approximate percentages for the three tests in terms of the material correctly produced were 90, 87, and 86. These percentages are to be considered upon a basis of 100 per cent recall immediately following observation.

The use of motion pictures in this connection has given some rather interesting results. A very extensive study has been made within the last few years upon this matter. Thousands of individuals were shown free pictures in various localities over the country and they were then tested for materials retained. Tests were made, for example, on the following day and at periods of one month, three months, and seven months. The data indicate that memory of specific features of motion pictures is suprisingly high. Even very young children can retain specific memories of a picture with a high degree of accuracy and completeness. The 2nd–3rd grade group, for example, retained on the average nearly 60 per cent as much as did the group of adults. Moreover, the retention of scenes from these motion pictures was surprisingly high over a relatively long period of time. A third of each group was not tested until three months after observation, yet the average scores for these groups were from 80 to 90 per cent as high as the groups which took the test the day after seeing the picture. A still longer period gave similar returns. Retention for different age groups at the end of seven months ranged from 57 per cent to 95 per cent of the amount retained the day after the showing.[1]

The results of these elaborate studies also throw light upon our previous discussion. Memorial production was best when it concerned (1) scenes of sports and general action, (2) scenes which were emotional, and (3) scenes dealing with familiar situations (home, school, church). In this connection, it should be pointed out that all formalized incentive to remember was *lacking* here, the purpose being to discover the effects of motion pictures upon the spectators; the particular test materials were not singled out from the mass of other material (comedies) given during the course of the evening's entertainment; and there was but one exhibition which occurred in a noisy theater filled with friends and acquaintances. Yet the amount remembered was astonishingly high when compared with the results of various studies on ordinary *learning* where reproduction at the end of a month commonly runs between 10 per cent and 30 per cent (non-sense materials).

2. *The Expert.* When the situation falls in his particular field, the individual who is highly trained (expert) in some line is always expected to give a more detailed and reliable account than an

[1] Charters, W., Haladay, P., and Stoddard, G., *Motion Pictures and Youth* (1933), p. 72.

untrained individual would. Since his professional training assists him, he actually observes more (he knows what to look for). Moreover, the long-established functional preparation which arises in part from his understanding that he is expected to give an accurate description serves as a further aid. Thus the expert *improves* himself. Outside his particular field, however, the value of his memorial reports may be no greater than those of any other *untrained* individual. Furthermore, since meaning is always involved, variations in it have an important effect upon memory. Thus an increase in meaning normally increases, within limits, the reliability or the faithfulness of a later report. The reliability may be great, but the number of memorial objects actually reported may be very few. Memory, then, can be improved, where improvement is defined in terms of the details produced by an individual in a particular situation under a particular instruction or preparation. There is accordingly no particular method whereby memory may be generally trained. Other things being equal, man tends to remember more when he observes more. And he observes more when the objects or situations are relevant to his purpose, when they are interesting, and when they are expected.

c. **Are There Memorial Types?** It was formerly assumed that human beings were endowed with particular types of mental furniture or imagery. As a result, some could remember very easily in terms of vision, others could remember easily in terms of audition, and still others could remember most easily by using other kinds of images. The pedagogical implications here are obvious. If the eye is quicker than the ear and both are quicker than the hand, emphasis should be laid upon vision. The old pedagogical maxim was: The shortest and quickest way to the brain is through the eye; the visual type is the best (fastest) learner. Science has revealed no experimental confirmation of such alleged functional peculiarities. It has not shown any particular type of imagery to be peculiar to an individual nor to any form of achievement. Despite this, a writer [1] recently remarks that "an individual of a visual type is probably more successful in remembering words, colors, landscapes, and similar material; an individual of the auditory type, in remembering musical selections of all sorts. Which type is absolutely best is not known." The

[1] Pillsbury, *Fundamentals* (1934), p. 521.

number of different kinds of objects or properties named within a given time is no indicator or measure of types of imagery.

It is now recognized that individuals unquestionably differ in terms of their memorial products. But the differentiating lines cannot be drawn between sense departments (visual, auditory, etc.). The same individual, for instance, may have good visual memory for some objects and poor visual memory for other objects. The illustrations which we have just given should make the point clear. The reliability or the fidelity or the efficiency of memory depends, within the limits set by heredity, upon how particular objects and situations are perceived. Individuals may not at times perceive closely in vision. As a result, they may fail to remember various features of visual situations. If they are properly instructed, however, they may do much better. Or, they may observe their environmental situations more closely in terms of "audition" thus their memory is more efficient.

Where normal perceptual functioning is possible, the particular ways seem, within limits, to be relatively unimportant. The functional product or observed thing, when regarded in terms of its meaning, may be identical. We have said that the *class meaning* or property of an object, e.g., an apple, may be variously perceived; that is, the apple may be felt, tasted, smelled, or seen. It can, of course, be remembered in quite the same manner. Moreover, it can be *verbally* described or *manually* drawn, without at the same time being felt, tasted, smelled, or seen. As an extreme illustration, we may know, for example, that two mathematical "freaks" may show approximately the same speed and accuracy in solving problems. One of the two may possibly report that he "sees" the numbers, while the other reports no visual memory. What is true here, holds generally. There is no relation between effectiveness of production or achievement and a particular type of functioning. In a great many cases of memory, it is impossible to find any visual, auditory, or tactual *images*.

1. *Memory Not Dependent upon Simple Mental Images.* We wish to stress at this point the *scientific* impossibility of regarding man's memory of things as being dependent in some manner upon mental images.[1] Memory is really a way of functioning. It is to be differentiated from other psychological functions in terms

[1] Where such images are regarded as being unanalyzable and meaningless elements of mind — elements which are the alleged building blocks of experience.

of the nature of its products. The products are simply objects or meaningful things which show various properties, some of which are both like and different from those of perception (e.g., time and place). There is no scientific justification for assuming that any thing — any intermediate agency of a psychological nature — stands between *brain functions* on the one hand and observed *object-properties* on the other hand. With brain function, there comes meaning; or, strictly speaking, meaning represents one stage in brain function. A brain functioning in an environment directly produces meaning. A functioning brain without an environment or an environment without a functioning brain is inconceivable. It is as impossible to have certain brain functions without meaning as it is to have meanings without brain function. We have yet to discover any adequate description of memory which is based upon an *observation* of mental images.[1] No experimental investigation has ever revealed mental images as serving as the *necessary* means whereby an individual arrives at some memorial end. What man observes are really meaningful characteristics of objects and situations.

Man always trafficks with objects in terms of their psychological properties but never with mental elements. No scientist has ever knowingly effected a separation so as to produce just an image on the one hand and a physical object on the other hand. In every case, we suggest, a meaning (object) is primary and non-derivative. So-called mental images are not *primary* (first), while the observed objects of the world are derived in some manner from them. The meaning (a property) which is really a functional product of man is wholly irreducible (unanalyzable) to a simpler status. Any particular meaningful aspect may, however, be *abstracted* for purposes of scientific description. But this is not a breaking a thing into elemental pieces. What we suggest here is in complete accordance with results obtained from various experimental studies upon the rôle of images.[2] Careful investigation thus shows that thinking, for example, may readily go on without mental images. But it never goes on without *meaning*. Men think out the solutions of

[1] Robinson remarks that the most skillful observer may have a definite thought without being able to say that it is visual, auditory, or kinaesthetic imagery (*Man*, p. 139). Hicks writes that there can be memory of a very reliable kind without any representation in the form of an image of what is remembered (*Brit. Jour. Psychol.*, *15*).

[2] What commonly passes for images are really functional products. An "image" of a man is not a bit of mental stuff or a mental element.

many significant problems. But they never report the use of meaningless images. If an "image" of an object arises, it is itself a meaning. A mental *element* (image) could not, for instance, have the shape and color of a horse. We may note in this connection that one writer remarks in part that the realities of life are not elements but units. We see these larger units in perception, we recall them in memory, and we use them to solve problems and to arrive at conclusions in reasoning. We are aware of meanings first and then *build up theories of the presence of elements* to explain how the meaningful experience originates. The very fact that one knows so little of the character of one's images and is so sure of what they represent is sufficient evidence of what is real is the idea (object) intended rather than the images (21, *390* ff).

2. *Memory and Mind.* We regard memory as being in part a particular form of neural function whereby objects and situations are directly observed or produced. We accordingly hold that memory is in no sense a process of the mind, or that it is more mental than perception. We are forced to this position, since we find the same class object may be produced either through perception or through memory. Many properties of this object may actually be identical; all are psychological. In *perception*, various sense organs function in conjunction with the brain to produce the properties which characterize meaningful objects. In *memory*, however, sense organs play either little or no part in such functioning. In fact, memory may normally remain quite unaffected in those cases where blindness or deafness develops in the adult. Such evidence points to the brain as being a major factor in the memorial functions.

d. Neurology. A large amount of experimental and clinical literature has gradually been accumulated upon the problems of brain functions. The World War contributed a great deal of material to man's understanding of many cortical activities. Pathological cases, such as are involved in tumors, have also shed light here. In those cases in which the cortex has been exposed and mild electric stimulation has been employed as an exploratory tool, significant data have also been obtained.

All this evidence, regardless of the manner of its collection, points clearly in the direction we have repeatedly emphasized, *namely*, that when the brain functions in a particular manner meaningful objects (objects which possess various psychological

properties) are directly produced. The objects may be spatially localized, for instance, in the field of vision; they may be stationary; or they may move at varying rates. When the occipital regions are functionally involved (stimulated), the individual usually sees many unlike objects, including human beings and various animal forms. That is, various meanings immediately arise; images do not come first followed in a few seconds by meanings. The individual simply sees things now of one sort and now of another. In short, such psychological properties as color, size, shape, distance, movement, familiarity and class may be descriptively reported. When other areas are stimulated, the individual may hear various objects — people, animals, etc. When cortical areas are painted with strychnine, for example, various objects may stand out in striking clarity. We approach in this way an understanding of the rôle of the brain in producing hallucinatory objects.

Meaningful things directly appear as an immediate resultant of the stimulation of the brain. Other functional products, among which are action patterns, also appear. The bodily members may move at times as when an individual carries out some pattern. Recently in Ohio, a man was attacked by inflammation of the brain. He talked continuously for ten days, during which time he discussed all manner of things. Part of it was as coherent as the steady flow of imagined, remembered, and perceived objects in the life of an ordinary individual. With the talking also went almost continuous movement of the bodily members. Speaking seemed clearly in this case to show its nature, *namely*, a form of action pattern comparable to the patterns involving the arms and legs.

By brain exploration, the significance of intra-organic factors in the psychological functions is more clearly revealed. The same form of mild electric stimulation of the cortical surfaces gives rise to a striking variety of functional products. The individual may possibly describe them in as great detail as he does an ordinary perceptual object. The person observes something and speaks about it. If we may properly assume that the brain functions of the intact individual are essentially of the order as indicated in such clinical studies, our understanding is materially increased. The objects of memory or imagination accordingly issue directly as a result of cortical functioning. The question as to *where* memories (objects) are retained can have but one answer. They are not stored in a mind which has the power to push them to the front

when they are needed. No method of science is adequate to show that ideas are stored any place within the organism. Nor are memories stored in the nervous system. To assume this is really equivalent, we suggest, to assuming that a gland has a great deal of glandular secretion stored up in it which it may release from time to time under direct stimulation. The student should understand that the nervous system functions to produce objects through perception. Permanent changes are thereby produced in the nervous system. As a result of these changes, it functions (through memory) to produce objects. That is, situations may be observed as having occurred previously. This is all that is intended in memory. A modified brain functions and particular meaningful products emerge. *What is produced lies outside the nervous system.* It may be either an observed human or a non-human object which has few or many psychological properties. The only evidence that man actually possesses concerning his memory is to be found solely in the nature of the product.

The brain, we assume, functions as a whole. Lashley's experimental work furnishes clear evidence of this fact. We definitely reject any explanation which is put in terms of a relatively small number of nerve elements joined together in serial order. Memorial properties, like the sweetness property of sugar molecules, depend upon a total pattern. If one knew how the brain functions in perception, for example, he would also know how it functions in memory.

e. **Heredity.** As previously stated, we assume that there is a very significant approach to a basic understanding of these functions. We hold that the ability to observe these various properties of environmental objects under direct brain functioning represents an inherent functional property of man. It is, in short, as inherently determined as digestion or glandular functioning. It is a functional characteristic of man which has been established in him through a long developmental process. It is in part a racial contribution. It is quite as inexplicable when approached in any other manner, as a fundamental property of a chemical or a physical substance. But the particular product which is observable at any time is unquestionably dependent in part upon the way in which the organism has been stimulated and has functioned in the past. While heredity plays a unique rôle, so do the environmental situations which the organism has faced. The adult individual who has been blind from birth is unable, for instance, to describe visual

properties. He has never observed visual situations. If he has seen, however, during his earlier years, he may observe visual objects in memory during the remainder of his life.

Memory, considered as an ability to deal with situations, must be regarded as being an inherent property of man which appears under proper conditions. Even where vision, audition, and smell are absent, excellent memory may appear. The life of Laura Bridgman may be cited in evidence of this point. Helen Keller, too, is lacking in sight and hearing, yet she is recognized as possessing a normal memory. That is, she is able to remember objects and situations which she has observed. That memory is seemingly a function involving the cortex (not particular sense organs) is seemingly evident in her life. Although she unquestionably observes many things by way of memories and dreams, no evidence has ever been obtained to show, for instance, that she moves her fingers as a bodily basis of such functioning (memory or dreaming). Yet her sole avenue for conversing with others, before she learned to speak, lay in the use of her fingers. To speak loosely, she does not seem to "think" (remember, etc.) with her fingers. Her case is striking in that it shows how particular modes of functioning may be greatly restricted in human beings without any discoverable effect upon achievement in so far as such involve memory, imagination, thinking, learning, intelligence, and personality.

f. Psychology. Psychological factors also play a determining rôle in memory. Such non-memorial factors as intention, purpose, instruction, understanding, and observation serve as causal agents. There can be no memory of a thing, of course, if it has never been observed. The wife who reproaches her husband for his poor memory concerning the nature of the clothing worn by the wives of his colleagues may find it difficult to believe that he did not observe them. She would have immediately observed such objects. The intention to remember must not be minimized. The mere statement; "I shall remember this as long as I live" may instruct one memorially. Many experimental studies have shown that one may repeatedly observe objects (words, syllables, and numbers) without being able to reproduce them at a later time. But when intention becomes a part of the total situation, later production comes very quickly. Merely being interested (emotional coloring) may be all that is required for later production. Memory depends upon the emergence of psychological properties

in the original perceptual situation. In a great many cases, the only property that appears in perception is that of *class*. For example, we can readily remember that we saw a man — and not a horse; a car — and not a wagon; a tree — and not a house. But we cannot describe the man, the car, or the tree in terms of color, size, or shape because such particular properties did not emerge. There was instead just a *class* meaning. If the student will examine his own life, he will readily discover how very frequently this sort of thing actually occurs. It outnumbers all other forms of perceiving and remembering. Moreover, we often remark in recalling a situation: "There was something over there or some object over here, but I cannot really describe it." We do not say, however, that we did not *observe* it. We can merely say that we did not observe its shape, color, etc. We simply observed *something* or an object.

Of the time or dating, we can say that in most cases it is seemingly an integral property of the memorial situation. This is true, if time actually *emerges* as one feature of the original perceptual situation. But we cannot surely expect such dating to appear, if the observer at the time of the original experience did not know the date or if the date had nothing to do with the event. The fact that man does produce many *datings* as immediately and as directly as he does many other features of an earlier observed situation should contribute to our understanding. In short, we assume that the time dating of many situations may be given in this simple way: "It was on April, the twentieth, in '75." If time emerged in the original situation, it may long persist. A particularized dating may not appear, yet the reference may clearly point to an individual's past. At other times, the dating seems clearly to be ordered with respect to another dating. The *second*, however, stands out because it is a wedding day, the time of our friend's death, the year of the great earthquake, the week of the Derby, or the Christmas on which "I was given my first gun."

> "Pattering over the boards, my Annie who left me at two,
> Pattering over the boards, she comes and goes at her will,
> While Harry is in the five-acre and Charlie ploughing the hill.
> And Harry and Charlie, I hear them too — they sing to their team,
> They come and sit by my chair, they hover about my bed —
> I am not always certain if they be alive or dead."
>
> — From *The Grandmother*.

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OUTLINE

CHAPTER XIV. IMAGINATION

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  b. The Product of Imagination Is Unique
  c. Old and New Properties
  d. No Wholly New Imaginational Objects
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CHAPTER XIV

IMAGINATION

A. *Its Nature*

Imagination is a functional property of man that differs in certain respects from those other activities which we have previously discussed. In perception, for example, an object is observed to be present. An individual sees, hears, touches, or smells it at this moment. It commonly possesses spatial reference. Visually speaking, the object exists in a certain place with respect to the observing organism — it is over there or over here. Moreover, the object *accords* with the totally perceived situation. In memory, something is observed as belonging to the individual's personal past; he may accordingly describe a memorial situation in great detail. But to do this he does not have to see, hear, touch, or smell it as we use such terms in perception. In general, then, the way of memory is not the way of perception. Neither is like imagination. As a result of the latter mode of functioning, man is able to deal at this present moment with situations as they may be at some particular future time; he may deal with them as having no particular time property; or he may deal with them as existing at the moment. Under the last condition, hallucinations may possibly exist, provided the object possesses certain characteristics which we shall later consider.

In imagination, then, man always deals with particular situations or objects. The particular thing may be one that has been perceived many times, it may be one that has often been remembered, or it may be something which man has neither perceived nor remembered. For example, I may today perceive my friend. Tomorrow, I may remember this same friend to be that individual whom I perceived today. And today or tomorrow I may imagine my friend as he will be when I again see him. In this last case, he may be exactly as I see him today, or, he may be greatly changed as a result of an accident or disease. It should be understood

that the object perceived, remembered, or imagined does not necessarily change in every respect as a result of a change in the way in which the organism functions. The mode changes because the total situation involving various causal factors is somewhat different in these three cases. The same nervous system is concerned, of course, in each case; but the outcome or product differs in certain respects. Because of this dissimilarity, we say there are three unlike ways of functioning.

a. Other Distinctions. The differences among these modes or ways of functioning should now be a little clearer. In this particular illustration, for instance, the product in each case is actually *my friend* as he *is* (perception), *was* (memory), and *will be* (imagination). The student should not be guilty of mistakingly assuming that because my friend is *perceived* he thereby becomes a *real physical object*, but that because he is remembered or imagined he becomes a *mental object*. In other words, the student will not confuse the object as a psychologically existing thing with an object as a physically existing thing. Moreover, he will not confuse a particular product with a particular psychological function. Function and outcome are intimately related, but they are not identical. If we draw a very *arbitrary* distinction, we can say that function is a process but that *observed* object is a product. The particular nature of the product unquestionably gives significance to the process. For example, it serves in part to distinguish it from others. It is, we say, a particular kind of process.

b. The Product of Imagination Is Unique. The functional product of imagination is unique in one or in several respects. Such psychological properties as color, size, shape, and familiarity of an imaginational object may be like (or different from) those of the same object (class property) under other conditions. I may, for instance, imagine my friend as being bearded, or deeply tanned, or quite portly. Regardless of the nature of particular properties, there is in each case at least one characteristic which is wholly unique. It may be merely one of time. I can imagine my home as it will look tonight; the classroom as it will look tomorrow; or my car after it has been shined. It may be some non-temporal property. The time may be now, but the objects may not accord fully with others in the total observed situation. The various objects which often appear as one functional result of the use of a

drug should clearly illustrate this point — they do not fit into an observed situation. Moreover, the objects of imagination are at times relatively strange or even fantastic because properties which an individual may regard as being characteristic of such objects, are different. A friend may accordingly assume a bright green skin color; he may develop an elephantine proboscis, or he may show Lilliputian dimensions.

c. Old and New Properties. Old objects may thus reveal wholly new properties or new objects may possess old properties. A father may actually be invested, psychologically speaking, with new properties which cause his child to fear him; he suddenly assumes dangerous characteristics. We may therefore understand that although a child may readily admit that a man is his father, yet he may also be quite afraid of him. A perfectly normal child may run screaming in terror from its father when the latter plays a game of "bear" with it. Among functionally disordered personalities, symptoms of an imaginational character are very common. If a child, for instance, should continue for some time to fear its father after he has ceased playing "bear," we should have a mild symptom of abnormality. Again, an observed object which is quite new or strange in certain respects may possess other properties which are familiar or old. Most imaginational objects clearly represent this sort of pattern.

d. No Wholly New Imaginational Objects. It is possibly true that man cannot imagine an object which is wholly *new* in terms of every property. As evidence of this fact, let the student now attempt to imagine how X-rays would look to him, or how a rainbow would appear to one who has never seen. He can, however, readily imagine a thing as possessing certain properties which make it unique as far as a particular class of objects is concerned. Is there, for instance, a creature which has fur similar to that of a beaver, which has a bill similar to that of a duck, which lays tough-skinned eggs similar to those of a reptile, which has webbed-feet similar to those of a frog, and which produces milk to feed its young which cannot suckle? This might appear to be an imaginational object.[1] It seems to be true that for artistic, literary, and scientific purposes man does not commonly imagine objects (properties) which are utterly different from others. On the contrary, he usually produces a few new properties and then presents the objects

[1] Consider the Duck-billed platypus.

to his fellow men. The imaginational objects of children are normally treated in this manner. Thus ordinary animals may be made to talk, ordinary plants may take on enormous size, or stationary objects may be given movement. Too many changes in object characteristics may actually be undesirable, if for no other reason than that there is a limit to imagination. If pressed too far, it may fail to satisfy.

e. The Products Are Unitary. The products of imagination are always unitary. They are, in fact, objects which show various meaningful characteristics. Such essential characteristics cannot be descriptively reduced to a non-meaningful or non-object status. There are, for instance, no sensations and no images (simple or complex) to be discovered in imagination. So far as observation is of direct aid to him, man does not find independent mental *elements* on the one hand which he can separate from the observed objects of a situation on the other hand. He simply observes some thing in terms of one or more of its several psychological properties. No scientist has ever observed, for example, that he possessed an image of a mental sort and that from this image he was able to obtain some object in his environment. Things — psychological objects and situations regarded in terms of their several properties — are not derived from mental substances or mental energies or mind or consciousness. Speaking strictly and specifically, no individual has ever *analyzed* observed objects and thereby obtained meaningless bits of mental stuff. Certainly he has not analyzed *physical* objects and secured mental elements. Nor has he ever abstracted a bit of mind from a *physical* object. In short, no one has ever approached a human mind by way of an *observed* situation. But man repeatedly observes (in perception, memory, and imagination) that certain objects (human or non-human) possess certain distinctive properties and that other objects possess other properties. He may readily "abstract" one of such properties in order to describe and measure it. But during this time, psychologically speaking, he is always concerned with a particular property of a particular object. The object property unquestionably depends, in part, upon his own nervous system. But dependence is not identity. Without brain function, for instance, an object would not be seen. But we cannot reduce the object which is seen to the *brain* itself. In short, the products of imagination cannot be reduced to a non-imaginational level.

· **f. The Products May Be Satisfying.** The object or situation of imagination often presents an outstanding property. It is individually satisfying — it is sufficient. Its satisfyingness may in fact be its sole justification. That is, no goal must necessarily lie beyond the situation to give significance to it. Many situations which are intrinsically gratifying are accordingly produced in this way. A great deal of imagination, we suggest, is of this type. It seemingly runs throughout all human life — it holds for the adult as well as for the child. The world of play, reverie and phantasy, as far as imagination is involved, is striking in this respect. The situations which appear in these cases are usually satisfying. When they are not, they normally disappear.

In other cases, however, the products of imagination may not be satisfying in themselves. Thus imagination runs its course at times under the guidance of a definite goal. The satisfaction in these cases may take many forms. An individual may possibly write a story or a description of an imaginational sort in order to point a moral or to satirize some condition. The scientist uses his imagination partly to manipulate his experimental objects and partly to introduce order and relationship into his world. In these as well as in other situations, such functional products become peculiarly significant when considered in terms of their contribution to man's understanding and further achievement. A goal property, then, may be either lacking or present. Its absence or its presence depends upon the needs of the individual and the nature of the life situation.

B. *Relation of Imagination to Perception*

The student may possibly secure a more adequate grasp of the nature of imagination by comparing it with perception. At times, the products of the two cannot be distinguished. Perception may then be confused with imagination. Some individuals who are not pathological may see, hear, taste, or feel an object in imagination so clearly, vividly, and congruently that *for the moment* they may actually accept the object as being perceptual. Moreover, while working in the laboratory under proper instructions, individuals may be unable at times to distinguish these functional products. Probably very few persons pass through life without having observed an object although they may have been unable to discover any environmental source to account for it — for example, they

may have heard some one call to them without their discovering one who could have called. Furthermore, in the brief period preceding sleep when one is partly asleep and partly awake, or during periods of great fatigue, various imaginational objects may be as directly observed as many perceptual objects are. Such (in sleep) are commonly known as hypnogogic objects. They may clearly show such ordinary properties as movement, shape, color, sound, and familiarity. Partial hallucinations may appear in forty-eight hours without sleep. Under these conditions, one may be quite sure, for instance, that the telephone rang or that some one spoke his name.

a. Eidetic Objects. Under instruction, normal individuals may report that an imagined (or remembered) object possesses many properties identical to those of a perceived object. This is strikingly true of eidetic individuals. Such persons are apparently able to produce an object which has as much clarity and stability as the so-called after-image of other individuals. This product appears particularly among children and adolescents. Some studies have shown that one-third of the individuals of unselected groups may report these objects. Such individuals need but stop and deliberately observe with the intention (instruction) to see a particular object. It tends immediately to localize itself upon a wall or some other surface at which they may look. They actually see an object which, under instruction, they are able to describe in considerable detail. Such objects may be quantitatively studied by having individuals compare them at varying distances with perceptual objects having the same properties of size, shape and color.[1] These products tend gradually to disappear with increased age. They seldom appear in adults.

b. Partially and Wholly Hallucinatory Objects. 1. *Vividness and Congruity.* Among the imaginational products which most clearly approach those of perception are the hallucinatory objects. Strictly speaking, the term " hallucination " refers in our discussion to a non-perceptual product which is either momentarily or permanently accepted by an individual as being perceptual. Eidetic objects, for instance, are not fully hallucinatory because the observer is instantly able to differentiate them from perceptual things. Furthermore, a great many objects which individuals clearly observe as a direct functional result of the use of drugs are not hallucinatory. Like the ordinary eidetic objects, they do not

[1] See a study by Gengerelli upon his sisters and brother.

fit into the total observed situation. They are not sufficiently congruent; they fall short of hallucinations. A hallucinatory object is accordingly more than a *vivid* imaginational object. It is one which accords with life situations. Mild partial forms appear from time to time in the lives of many individuals. They are mild because their nature may be shortly recognized. The closest *approach*, perhaps, to a hallucinatory object in *everyday* life without actually being such may possibly occur when some striking bit of melody repeatedly runs "through the head." It seems to arise most frequently from hearing a melody when one is mildly emotional. Perhaps this was what the poet was considering when he wrote that it "hurts like a haunting refrain."

2. *Drugs.* Under the influence of drugs and in certain physical and psychological diseases, this confusion of functional products becomes quite evident. The cocain addict, for example, will shrug and twist and rub and scratch in order to remove the tiny (imaginational) objects which usually crawl just under his skin. Objects which possess various psychological properties of a strikingly vivid sort but which seldom approach a full hallucinatory nature appear usually under the use of mescal (peyote). Some very interesting descriptions have been given of the many objects which are observable while under the influence of this drug.[1] One individual reports that "objects of all kinds," either colored or colorless, stationary or changing, appeared and disappeared. Some of these definitely emerged as a result of a particular instruction and took their places in the visual field. Others seemingly came without rhyme or reason. The descriptions of another individual clearly reveal the nature of those functional products. For example, he saw "the upper part of a man with pale face and red cheeks rising slowly from below" the level of vision. At another time while he was *thinking of his friend*, the head of an Indian suddenly appeared. Here the instruction was less effective. With eyes closed, he also observed, localized in space before him, a red flag flying from a pole. The magnitude of these imaginational objects tended to remain unchanged with eyes opened or closed. At the full height of the influence, the walls and floor were closely covered with various objects showing many properties — color, size, class, and movement. With mescal, the imaginational objects do not seem to attain the full hallucinatory nature that they do with other drugs.

[1] See the work of Fernberger and Klüver.

De Quincy, for instance, has given some very detailed descriptions of the nature of the full hallucinations which accompany the use of opium. Furthermore, under hypnosis, "normal" individuals may apparently observe imaginational objects in quite the same manner that they do perceptual objects. Such things may be hallucinatory because they may actually constitute the individual's environment; that is, he may not observe *anything* more. Or, if he does observe other things, they are either made to accord with his "hallucinatory" objects or they are disregarded. Under these several unlike conditions, therefore, we discover objects ranging from mere vividness to full hallucinations. The key to the hallucination apparently lies in the *environment*. If the observing individual is always able to differentiate between what he perceives and what he imagines, there is no hallucination.

c. Dreams. Although we shall shortly discuss the nature of dream objects, we must point out here that they normally assume in every respect the essential properties of perceptual objects. In general, they are even more hallucinatory than the objects and situations observed by individuals while under the influence of drugs. Upon subsequent wakening, both child and adult may possibly confuse these products. Timid children may dream and then be so afraid that they refuse to sleep alone. Normal adults at times confuse that which they dream with that which they perceive. They will occasionally refer to the products of a dreaming period as having been observed under waking conditions. Timid adults may even trouble to look around their bedroom to assure themselves that the objects which they had just observed were dream objects. The evidence gathered upon eidetic, dream, and hallucinatory products is illuminating; it indicates that normal individuals have not been endowed with any unique power by which they may infallibly select the "right from the wrong," or sift "the true from the false." It shows how closely man is tied to the objects of his life situations; also it reveals the thinness of the veil which separates normality and abnormality.

Man functions psychologically in his dreams. As far as he is concerned at the particular moment, that which he produces usually has every "ear-mark" of a perceptual situation. The things which are observed are accepted at their face value. As far as a *perceptual* situation is *real*, the *dream* situation may also be said to be real. We assume here as we have elsewhere that,

strictly speaking, whatever exists under a particular set of conditions is real in some respect. Scientific necessity demands that we accept this position. Everything which exists unquestionably has a cause. An object which appears under a particular set of conditions must be real. To deny reality, as we regard it, is actually to deny causation. It is only in psychology (among the several sciences) that we stumble upon the cumbersome notion of unreality. The human mind has allegedly been endowed with strange properties by virtue of which it is able to do peculiar service. One service has been to create unrealities. We find no scientific reason for recognizing an agency of this sort. We accordingly suggest that when he drops his dualistic notions about the nature of man, an individual clears the ground for straight thinking. He is then able to understand that a change in *one of various possible causal conditions of a thing may actually change the nature of a thing.* But the change is never from reality to unreality or from unreality to reality. Imaginational situations as in the dream appear under one set of causal conditions. Perceptual situations as in waking life appear under a different set of causal conditions. The former, however, are no less real than the latter. By awakening, one does not pass from unreality to reality in any psychological sense. Furthermore, we shall not regard dream objects as being illusory. We shall accordingly be better able, for instance, to understand the individual (aviator) who possibly dreams of falling in a flaming plane and who sweats, trembles, and possibly finds further flying to be more difficult. We shall also understand that the necessary courage which he may find in drink is in no sense false.

C. *Imaginational Products in Life Situations*

a. In Art and Science. Among the various forms of imaginational products we may list those of the poet, the musician, the inventor, and the scientist. Although these are not inclusive, they are representative. The poet is limited in his production only by his imagination, the nature of his theme, and the appreciation of his audience. The poetry of Dante, Milton, Tennyson, and Poe undoubtedly appeals in part because of the sublimity and the beauty of the imaginational picturing. The striking products of men of their type are unquestionably unique. They stand as

conclusive evidence of a kind of achievement utterly impossible to the average man. They furnish tangible proof of man's functional inequalities. Some men are undoubtedly great because they have been endowed with an unusual form of imagination. Bach, Mozart, and Herbert must rightfully be regarded as possessing unusual types of imagination. Mozart at eleven years of age without any outside aid wrote a brilliant oratorio. At thirteen he was appointed grand ducal concert master and in this year wrote twenty different compositions. Victor Herbert would often compose two different selections at the same time. He would walk back and forth between two desks, working now upon the one and now upon the other as his imagination furnished the materials.

1. *Musician.* As an illustration of a contemporary composer, we refer to Cowell, who was one of Terman's cases of superior individuals. According to Terman, he stopped school at the age of seven. Because of his high *I.Q.*, Terman was inclined to believe that, if given an opportunity, he would show superior achievement. Cowell writes in part of the experiences of observing glorious things which would often appear wholly unexpectedly. Among these were original *melodies* and complete *harmonies* such as could not be conjured at will. He was quite unable at times to exercise control over the flow of these imaginational objects. He writes that he usually composes "around a theme for several months before it develops into its final form as written. By trying the initial idea over mentally in every conceivable way," he is rarely forced "to change a note after a composition is written." Here, we suggest, is striking evidence of objects existing in great detail in imagination before there is any final expression in physical form. The perception of them in written form coincided with their imaginational form.

This is essentially identical with the inventor who may produce a thing in imagination which has shape, size, and movement before he uses his hands to create finally a perceptual object which possesses every one of the psychological properties of the imaginational object.

2. *Inventor.* The inventor either produces some partially new object in imagination, or adds a new part to a previously created object. At times, the inventor, instead of imagining, may think out the solution to a problem. This function we shall discuss later. In most cases of imagination, some object seems more or less grad-

ually to assume its diverse characteristics without either the effort or the critical use of many facts normally required in thinking out problems. It is recognized that men may have many inventions to their credit of which some are very dissimilar. It would not seem, therefore, that inventors must necessarily have years of intensive training in many unlike fields in order to produce. Certain individuals appear actually to possess an imagination which thrives upon inventive occasions. In such situations, however, the average individual remains functionally helpless.

3. *Scientist.* The scientist finds a variety of uses for his imagination. He employs such functional resources in producing hypotheses or suggestions, in formulating a plan of attack upon an experimental problem, or in relating one object to another. In the case of the chemist, for example, the object which represents the spatial arrangement of the atoms comprising a molecule of a substance represents an imaginational product. Concerning the significance of this function, one scientist remarks that in coördinating the facts of experiments, chemistry is compelled to draw upon man's imagination, controlled by critical questioning. It has found the most satisfying interpretations of scientific observations in conceptions that involve rapidly moving material particles which are far too minute to be individually seen, weighed, or counted. The whole thought of chemistry is evolved from the application of intelligence and imagination to experimental results.[1]

b. In Everyday Life. 1. *Anticipation.* Our brief account of the different types of imaginational products would be quite inadequate if we failed to comment upon those which appear in the life of the ordinary man. We wish accordingly to refer to those forms found in anticipation, manipulation, play, planning, reverie (day dreams) and the dreams of sleep. While these are not sharply differentiated types, they do show sufficient differences at times to justify distinction. Some of these products may be satisfying; others may not. Some are clearly hallucinatory; others are clearly not. Some bear a definite time reference; others do not. In anticipation, for example, a situation is produced as something to be realized in the immediate or in the more remote future. The individual functionally reaches into the future to create an about-to-be or a will-be realized situation. He may dwell upon tonight's reading of the next instalment of his favorite serial, the reunion

[1] Stieglitz in *Nature of the World and Man.*

next week with his old classmate, the forthcoming publication of his new story, or his impending visit to the dentist. In each of these cases, the time meaning is quite evident. It is tomorrow, next week, or some time in the future. The human organism is thus able through imagination to transcend the present and to produce a situation which may either greatly satisfy or seriously disturb it. Man is not psychologically bound to the more narrow confines of his perceptual environment. He is functionally free to go far afield. In short, he is bound only by the limits of his imagination and by the realization of his obligations to life.

We point out that this imaginational anticipation seemingly appears in its simplest form in connection with perceptual situations. The young child *perceives* its mother moving toward it with some satisfying object. In so far as the situation means that-which-is-about-to-be, there is imagination. Thus within the perceptual situation, there may be a short extension into the future. The functional limits are gradually enlarged; meaningful objects gradually emerge beyond the boundaries of man's perceptual situations (seeing, hearing, and feeling). The extension is slow, but it inevitably proceeds under normal conditions.

2. *Manipulation.* Imagination may again assume the form of manipulation. A *well-known* object for instance, may be psychologically handled or treated in various ways. I may in imagination move my desk from one place to another; I may divide my work table into two unequal parts so as to fit it properly into a limited space; I may arrange the divisions of my book in various sequences; or I may shift a part of an apparatus from the left to the right side. I may wish to direct an individual to the campus by the fastest route. I may move in imagination along one street, but suddenly discover through memory that it is being paved. I accordingly turn to another street as a possible way and give the proper directions. The student possibly realizes that in this imaginational manipulation there *may* be a definite goal which serves in part to instruct the individual. The functional products accordingly serve some *desired* end. The thing developed may be very simple or quite complex. On the other hand, there may be *no* goal. The manipulation may possibly occur because it is a source of pleasure. In each of such cases, however, there is usually no futurity; the objects are generally lacking in time meaning. There is no situational meaning of "coming" or "to-be,"

or "just-around-the-corner," or "looking-forward." Among the large number of life situations in which this imaginational manipulation of things occurs, perhaps none is more outstanding than the form found in play.

3. *Play.* Imaginational situations may possibly be characterized by the absence of satisfaction ; they may in fact be quite disturbing. But in play, this matter is fairly unambiguous. In such imaginational situations, objects are manipulated because of the sheer satisfaction that directly accompanies such treatment. It is difficult to understand play if it is not regarded in this manner; it is peculiar in this respect. When satisfaction declines or disappears, play shows corresponding changes. Play accordingly differs from that form of imagination found in sleeping dreams. The latter often continue irrespective of the pleasure meaning. Day-dreams, however, like play, usually stop when satisfaction ceases. It should now be clear that one does not play habitually, if this is understood to imply the manipulation of an object in a purely mechanical manner and without regard to satisfaction. Children play many games in which the various objects (human or non-human) of its environment are shifted about from one rôle or place to another. When satisfaction declines as a result of various conditions such as conflict, weariness, hunger, shame, or instruction, the game (situation) changes. Adult individuals, unlike children, tend to play games involving impersonal objects — objects which are literary, industrial, historical, social, or scientific. They may, for example, play at listing musicians, or poets, or writers, or articles with names beginning with a certain letter. If a non-playful factor, such as fear or shame, is introduced, what was play now becomes work or sheer boredom ; it is itself no longer satisfying. In its purest form, play shows no hint of functional preparation for "something else." There is no getting ready now for serious and non-playful situations in the future. There is, in short, no future as far as play is concerned.

4. *Planning.* In planning, however, we discover a definite preparation for future action. An individual deliberately sets a particular end to be achieved. Plans, which are here regarded as being functional products, are to be generally distinguished in this way from many other imaginational products. Planning also differs from anticipation in the form of the instruction. I anticipate my visit to the dentist. I plan what I shall do while there.

I accordingly instruct myself that if the dentist lets the drill slip too often I shall smile — not swear at him. As we have previously said, an excellent kind of functional preparation may be obtained through imagination. In this manner, one anticipates a situation and plans what he shall do upon confronting it in perception.

c. Day-dreams. 1. *An Orientation.* Students of psychology who assume that nothing is worth-while or is to be considered which cannot be experimentally studied or investigated by laboratory technique commonly make short work of imagination. They may enjoy imaginational products, they may recognize that sheer genius may be hung upon this one peg, they may realize that science must directly credit a significant amount of its materials to it, they may understand that our institutions for the psychologically diseased contain large numbers of individuals with disturbed imaginations, and they may grant that the course of history has apparently turned at times, as in the case of Joan of Arc, around such functional products. Nevertheless this particular functional property of man is relatively neglected. The student should critically examine any scientific position that *fails* to offer a place for a description and treatment of man's fundamental properties except as these are revealed solely through laboratory technique. If man's imagination, for instance, needs any justification for scientific consideration, it finds it in the personal satisfaction and in the temporary relief which are attendant upon *reverie.* Man dreams; and in so doing finds a degree of happiness (satisfaction). Psychologically speaking, happiness is a major goal, if not the end of living. Man's imagination contributes significantly to the total pattern of his life; it adds to the sum of his happiness. In this respect, man stands immeasurably above the animal level. Man builds his "castles in Spain" and in so doing finds an incentive for struggle, a refuge from troubles and a source of happiness. We are reminded in this connection of a statement by Scott when, utterly disappointed, he turned away from the South Pole to take up the homeward course. "The day-dreams are ended," he wrote, "it is going to be a dreary return."

2. *Causation.* The functional flow of situations in day-dreaming commonly moves on its course without apparent control. But underlying this stream and serving always to direct it, stand various determining factors of a psychological nature. We have seen that the situations which man perceives are partly determined by

purpose, intention, need, and desire. The same holds true of imagination. The day-dream is always caused. It arises in part from a historical basis. It is a functional way of producing objects which satisfy the individual because they concern his needs — needs which arise from an inherent basis and from his personal history. The hungry man dreams of food, the thirsty of water, the weary of rest, and the imprisoned of escape. Reveries turn constantly about situations which deal with the gratification of desires; they concern unfulfilled wishes and longings. In this sense, then, they are always directive. In his day-dreams, man either finds or continues to seek that which he misses in his work-a-day and social world. In them, he actually penetrates, psychologically speaking, the barriers erected around him by an inhospitable environment or by a narrow society, and thereby reaches a more glamorous region where for a time he moves more freely. It is not surprising, therefore, to discover that man's day-dreams are emotionally or affectively "colored." To eat when hungry or to drink when thirsty is normally pleasurable. And it is also true that in his reveries, man may momentarily allay his hunger and slack his thirst.

3. *A Form of Satisfaction.* The day-dream then may be properly regarded as being a way of escape from meaningful situations which fail to contribute adequately to man's satisfaction. Man accordingly creates — but not deliberately — in imagination a world so constituted as to contribute to his increased happiness. The understanding student will recognize that this world may actually be a real world, as far as the individual is concerned, while he is *functioning* in this manner. I have, for example, heard children during study periods suddenly burst into laughter. I have frequently found that they were so engrossed in their day-dreams that their perceptual environment (schoolroom) had momentarily dropped away. Often the adult individual may literally glow with the pride which accompanies some heroic day-dream. The puny and the weak may be swaggering soldiers loaded with booty, the disappointed artist may find his name heralded across the land, the bashful and retiring lover may turn into a gay Lothario, the thwarted spinster may be literally besieged with charming suitors, and the misunderstood student may be finally recognized by a slow-witted instructor, although possibly too late to remedy completely the wrong done him. In his dreams, he may possibly forgive but

never forget. He becomes powerful and changes things to accord with his desires. Such a list could, of course, be greatly extended; for the life of every man necessarily runs at times along these channels. No one always finds adequate satisfaction. When his dreams become completely satisfying, when he has wandered so far afield that he is unable to return to the beaten trails of his non-imaginational world, the individual is lost. He is, we say, abnormal.

d. Reading, Movies, and Play as a Means of Escape. Man may also escape through reading. The lure of a good detective story is chiefly imaginational. The lives of outstanding individuals clearly reveal the dependence placed upon such vehicles as means of escaping temporarily from the stress and strain of life situations. That men who are so intensely practical during their working hours should be able to cast aside the responsibilities of finance, industry, and government to accompany a Lone Wolf, a Diamond Dick, or a Sherlock Holmes upon an adventure is striking evidence of the profound significance of imagination. Men who cannot or do not find this way to be adequate may turn to the moving picture. Here they also find relaxation and momentary forgetfulness. They move in imagination through the situations and live for the time in a different world — a world in which they may laugh and cry. Persons sometimes return to their perceptual surroundings after such imaginational journeys with a clear feeling of regret and unpleasantness. Finally, in play man discovers a partially satisfactory way of escape. Here, as we have said, the necessity for certain types of social conformity may be momentarily relaxed; the pressure of convention may be slightly eased. Under these conditions, man may "return" to the happy patterns of his youth. He can again run, and dance, and sing, and shout with an abandon that is utterly at variance with the non-playful patterns of his daily life. Man plays in many ways. He may even collect various things. He may then find much satisfaction in arranging, studying, and planning about them.

When one reviews all these facts, he can possibly understand why certain people commit suicide while others do not. Children and savages, for instance, seldom take this way out. As long as he can play, man possesses excellent insurance against both suicide and insanity. A significant difference is to be found among various stocks or groups in terms of suicide rate as well as the frequency of

psychological diseases. If play does not serve as a causal factor in such matters, it appears at least to accompany a lower rate in these cases. We do not imply, of course, that this is the only psychological way in which man sustains himself.

e. Sleeping Dreams. Man commonly spends a large portion of his life in sleep. About twenty-five years of the allotted threescore and ten span go while man hides away from the world gripped in a functional condition which has defied all attempts at complete understanding. Science has discovered that during this period various physiological functions run their courses. We fully recognize, therefore, that digestion, respiration, circulation, assimilation, as well as many other organic functions, normally continue during sleep. Psychological functions also go on. It is rather surprising,

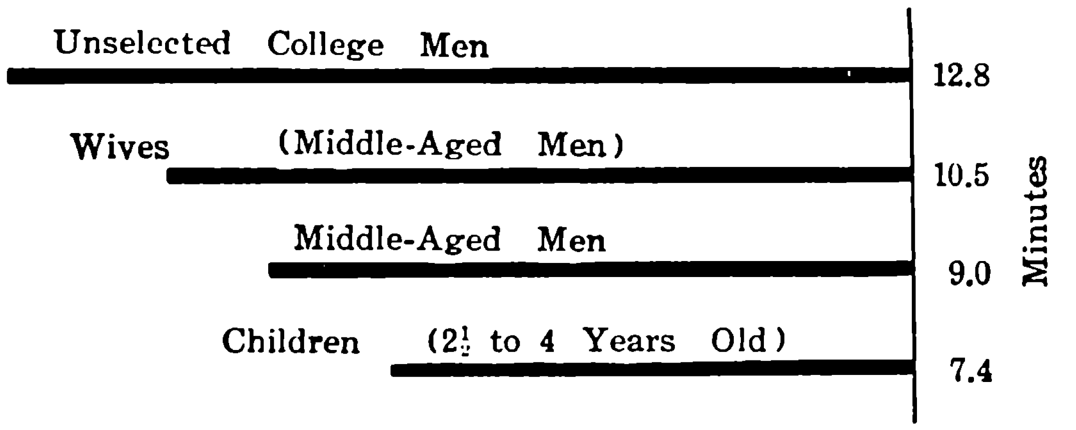

FIG. 83. Are young men more restless than middle-aged men?

despite the lack of exact knowledge of the nature of sleep, to find the mystery, the glamour, and the unusual — if not morbid — interest that generally envelop the matter of dreaming. As we regard this matter, there is actually no more legitimate reason for creating a mystery about man's dream products than is to be found in case of other functional products (bile or saliva). We assume that dream objects are the outcome of a particular functional property of man, *namely*, his imagination. We simply assume that man's cortical functions, among many others, continue during sleep. There seems to be no reliable evidence for assuming differently. Functionally regarded, man during sleep does not become mysteriously transformed through some agency into a strange creature. He merely continues to function; but at a lower level. This seems to be true of each function, either psychological or non-psychological. If this measurable decline in man's ordinary organic activities is properly understood, the student has gone far toward understanding man's dreaming. Figure 83 shows that individuals move about frequently in their sleep. The lines show

the comparative length of quiet periods for four groups of individuals (Johnson).

1. *The Objects.* The objects which appear during an individual's dreaming period are often no different in many respects from those which he observes during his waking life. One may handle familiar objects, talk with members of his family and with his friends, carry on the same tasks, and eat the same food. Experimental studies show that the larger percentage of the objects observed in dreams are quite familiar. This similarity or identity has significance. It points to some *common causal* factor. We do not assume that *wholly* different agencies are involved in waking and in sleeping observation. Some are unquestionably different; others are not. Familiarity indicates that man does not shed the results of his past relations with objects when he falls asleep. They contribute there as elsewhere to determine in part the nature of his observation. Too often perhaps for an adequate understanding of dream situations one aspect is unduly emphasized, *namely*, the unusual or the bizarre. Even in these cases, no peculiar or strange departure from waking life can be discovered. This fact becomes more evident when the imaginational products of abnormal personalities are considered. The greatest difference between man while sleeping (dreaming) and while waking is no greater than that which is to be found between a normal personality on the one hand and an abnormal personality on the other hand. And it is recognized, of course, that the abnormal cannot be separated from the normal in any mysterious manner.

2. *Some Properties of Dream Objects.* Dream situations (objects) regarded as functional products of imagination commonly show a degree of vividness identical with that of perceptual products. This becomes strikingly evident in those cases of dreaming in which persons may walk, talk, and act in ways which at times approach a normal, but *absent-minded*, condition. Such cases throw considerable light upon man's functional properties. The sleep-walker, for instance, may accept, handle, and avoid various environmental objects without difficulty or uncertainty. Food, for instance, may be prepared and eaten. Even conversation is possible. The reality of such dream situations cannot be questioned. Generally speaking, however, man has little memory of such objects. Upon awakening, the usual sleep-walker, for instance, commonly lacks direct information about his dream activ-

ities. Here an outstanding feature of many dream situations appears. Some are easily remembered and described. Moreover, the description may be as detailed as in the case of any situation observed while awake. Through his descriptions, we secure information about these functional products of man. The way is no different therefore from that to be found in any case where an object is perceptually observed and described. Observers, either scientific or non-scientific, report and comment descriptively upon the objects which they chance to observe. The method of reporting may therefore be identical, although the object may be perceptual or memorial or imaginational. Being awake or being asleep does not necessarily produce a difference in the object reported upon nor upon the mode of report except, of course, that the dream situation is usually described after the individual awakens. The descriptions in every case are put in terms of meaningful properties. Usually such psychological properties are visual, auditory, or tactual. But they may not be; they may be kinaesthetic, as in dreams of falling or in moving; or organic, as in hunger or in thirst.

3. *Determination.* (a) *Extra-organic* (*stimulus and time*). The nature of a dream situation is normally dependent upon two large sets of causal factors. At times, it is the resultant in part of extra-organic conditions. As a result of sensory stimulation, an object in the environment of the individual may be perceived as belonging to a dream situation. For instance, when a bell is sounded near the sleeping individual, he may immediately observe a situation in which a bell either directly or indirectly plays a part. A friend of the writer, who had remained up late in order to hear the verdict in the Lindbergh case, reported that when the alarm clock rang the next morning, he dreamed that a bell sounded as the signal for him to start his journey to the electric chair. He was much relieved, indeed, to find himself lying in bed. Many experimental studies upon dreaming have shown that the observation of one or more psychological properties of an environmental object may either initiate or be incorporated into a dream situation. Once it has been initiated it may possibly sustain itself — move forward just as in day-dreaming — over a varying length of time. The time may be relatively short; or, again, it may be quite long. To see an individual walking or to hear him talking in his sleep is convincing evidence that a dream may run a fairly long

course. During this time an individual may cover considerable territory.

In dreams, as in ordinary reverie, we may suddenly find ourselves a "thousand miles away." Environmental objects seemingly play a part in shifting the flow of the dream situations. A cold hand, a hard pillow, a slight push may serve in part to guide a flow of dream objects. The results vary greatly, depending upon the nature of what is perceived. When a cold object, for example, is placed against the hand of the individual, he may merely observe something which is *cold.* He may not necessarily classify the object; that is, he may not perceive a cold *hand.* It then becomes possible for this property to fit into any one of a large number of situations. In this manner, we may partly account for the great variation in the situations reported in dreaming under identical stimulus conditions.

4. *Lack of Correlation between Stimulus and Dream Object.* We must also assume that in many cases the brain is functioning at a fairly high level — that dreaming is already going on — at the very moment that a new environmental object is observed. The functional product that issues under such conditions may accordingly be very different from what we might expect from our knowledge of the nature of the stimulus conditions. For example, when a plaster is applied tightly to an individual's leg, he may possibly dream that he is kneeling, that his leg is caught tightly between two objects, that it is very stiff, that he is being tortured, or that he has been hurt and his leg is tightly bandaged. Different drugs also have different effects upon man's dreaming. An injection of pituitrin, for example, tends to be followed by dreams which are generally pleasant. Adrenalin on the contrary tends to bring distressing and unpleasant situations.

This extra-organic determination is essentially similar to that of waking conditions where a new form of stimulation, breaking suddenly into a functioning series, produces a change in the nature and direction of functioning. When it appears at one place in the series, it is followed by one sort of change. When it comes at another place, the change may be very different. It is accordingly impossible to predict the nature of a particular dream situation from a knowledge of the nature of the physical or chemical agents which serve as stimuli. The organism always brings to every situation either waking or dreaming, a major determining factor, *namely,* the intra-organic conditions.

(b) *Intra-organic* (*sleep and hypnosis*). Dream situations depend in part upon an individual's intra-organic conditions. He is never functionally inactive. Being asleep does not necessarily make profound changes in his activities. We point, for example, to the readiness with which a sleeping mother may perceive her child. At the same time, however, she may not hear many other things for which she is not instructed or about which she is indifferent — which are irrelevant. The sleeping individual may accordingly be specifically inclined toward particular objects of the environment. That is, functional relationships always exist between a human being and some other thing. In this general sense, the phenomena of sleep and hypnosis may be related. The hypnotized individual if properly instructed may not see or hear many possibly perceptible features of his environment. But he will see or hear other things including the operator. Whether sleeping or hypnotized, an individual may observe and at times act selectively.

5. *Organic Functions.* The dreaming organism is not neutral. In this respect, it does not differ markedly from the waking organism. Various organic functions, such as are concerned in sex and digestion, usually contribute either directly or indirectly to the course of dreaming. The dream situation is often built around the satisfaction of hunger, thirst, and sex needs. Every normal individual recognizes how very complete at times such forms of satisfaction may possibly be. We accordingly assume that other changes which go on in the organism to give rise to various observed properties of the body may definitely affect the nature of dreaming. Similarly, the wishes or desires normally characteristic of waking life may again appear during sleep. These may or may not be satisfied in the dream. The evidence indicates that the situations are more of a nature such as to satisfy rather than to deny. In dreams of sleeping, as in the ordinary reverie, the individual may find wealth, sympathy, honor, loyalty, understanding, and recognition. That which is denied under waking conditions may of course come to an individual under dreaming conditions.

6. *The Rôle of Past.* Desires and longings, then, are not without effect upon the sleeping organism. They are integral features of its history. It would indeed be strange if sleep were completely to cancel them. A major reason that dreams clearly center at times around various organic properties and conditions is simply

this: These properties play a part in our waking lives when satisfaction is derived. Individuals are concerned with food (eating) when they become hungry. Or they are concerned with drinking when they are thirsty. Feverish patients, for example, commonly report many dreams having to do with the satisfaction of their thirst. Day-dreams involving such forms of satisfaction are often as striking in this respect as sleeping dreams are. The conditions which initiate hunger, thirst, etc., are quite different, therefore, from those which are commonly involved in scientific, social, economic, or political dream situations. These seem to depend directly upon continuous changes within the central nervous system and not upon changes in the various bodily functions (digestion, etc.). Dreams accordingly arise from various unlike causes. Some apparently arise in part from normal organic changes within the organism but outside the nervous system; some arise directly from the continued functioning of the nervous system in the absence of outside stimulation. It is possible that the processes of growth, assimilation, and decay in the brain cells themselves may be very important here where environmental stimulation may be lacking.

Man not infrequently takes various features of his daily life — his failures and successes, his worries and his fears — to bed with him. He deals functionally with situations before falling asleep; and he may continue to deal with them after falling asleep. He cannot shed life situations as simply as he does his clothing; he cannot so discard his past. The various scenes and persons of man's dreams are drawn to a major degree (perhaps more than 50 per cent) from the materials of the preceding day and evening. Calkins, for instance, found that 90 per cent of dreams were definitely relatable to situations of waking life. The human companions of dreams were drawn in most cases from everyday life. As a striking bit of evidence upon the nature of dreaming, we refer to her studies in which no dream was reported with a change in the age of the dreamer. Generally speaking, the adult does not dream of himself as being a child.

Much of an individual's waking life is not concerned with sex, hunger, thirst, and other organic properties. It is not surprising, therefore, to discover a large number of dream situations in which there is no evident relation with such causal factors as sex, hunger, thirst, and fatigue. There is, moreover, no reason for actually

assuming any such causal relationship, unless a like relation is similarly assumed for waking life. Under the direct guidance of neural functioning, man's dreams may turn around ordinary topics and problems of his daily life. He may work at some purely mathematical task, he may dictate letters, he may drive around precipitous curves, he may put a wheel on his car, he may write a book, or he may find money on every side as he walks along the street. We must assume that man's brain continues to function in sleep although at a lower level than we find in waking life. The lower level is to be attributed in part to a decrease in the cortical blood supply. Whether this decrease is a cause of sleep or merely a physiological symptom of it is an open question. A like decrease normally occurs in fainting, which is functionally regarded as being in some respects quite similar to sleep.

7. *A Distinction between Waking and Sleeping.* Evidence clearly indicates that cortical functions run on except, perhaps, during deepest sleep. Such neural functions give us the situations of our dream life. When cortical functions cease, there are no dreams. When cortical functions are sufficiently raised to meet certain *criteria,* the individual is awake. The distinction is, at times, difficult. We recognize and describe differences in physiological functions in terms of the nature of their products. We know and describe differences in psychological functions by the nature of their products. When a person opens his eyes, gets out of bed, and walks past us and does not see us or answer us when we speak to him, we say he is asleep. When he is able to observe and describe certain objects in his environment in a certain way, we say he is awake. An individual may be awake, yet fail to observe many things. He may observe some one object so closely as to miss many others. The veil stretching between waking and sleeping is in actuality so thin that one may look at life from either side, at times, without momentarily being quite sure of the side. The functional products of waking and dreaming states may therefore be alike. It is not so surprising that confusion exists; but it is surprising that there is not more confusion. This lack of confusion becomes more striking when we recognize that man does not possess one sort of nervous system when asleep and another kind when awake. He uses the same agency but in different ways. We discover the difference in the ways, of course, by considering the difference in the products.

8. *Mind and Brain.* Dreams have at times been made into mysteries and referred to the operation of such things as a subconscious mind, or repressed (unconscious) wishes or a censorious mechanism which stands guard between the conscious and the unconscious. Some men write of a conscious mind which, during sleep, turns over control to an unconscious mind. Some even inquire among many other things concerning where the mind goes when the owner is asleep. An additional problem than arises concerning the manner in which he gets his mind back upon awakening. Since we have definitely discarded the concept of mind — conscious or unconscious — we shall disregard such topics. We hold that various determinable *organic functions* definitely rise and fall from hour to hour. Those involved in growth, metabolism, secretion, excretion, breathing, and circulation show this very clearly. They may be accurately studied. We similarly assume that neural functions rise and fall. When brain functions rise, man produces certain products. When brain functions fall, other functional products are produced. We do not assume, however, that his mind comes and goes under a rise and fall in brain function. The *meaningful objects of the world come and go,* just as physiological products appear or do not appear. Objects come in waking and they may go completely in deep sleep. Whatever continuity may be found in man's life necessarily depends upon the functional continuity of his brain.

9. *Continuity.* Man closes his eyes at night and, for a time, certain aspects of life may end for him. Psychological traffic stops. He opens his eyes in the morning and resumes his relations with objects. There may be nothing in his perceived environment (chairs, table, bright sun) to give him this continuity — to cause him to continue with that with which he was struggling when he came into his darkened bedroom at midnight. Not physical environment, but his own nervous system provides this continuity. It enables him to produce in memory, when awake, the objects of his waking situations. During sleep man "forgets" many objects. That is, he simply does not produce them. We cannot say, however, that he forgets mental objects by thrusting them away into a remote region of his mind. When he awakens, he again remembers *objects;* but he does not revive *parts* of his mind which have been away. We do not accept scientifically the existence of any such agency.

10. *Dreaming and Depth of Sleep.* The results of studies indicate that individuals dream more continuously than might be expected from the nature of casual reports. The assumption that persons may dream yet be unable upon the following day to recall having done so finds confirmation in such studies. The method of having individuals write down their dreams upon the first moment of waking has shown the existence of a surprisingly large number of dreams in individuals who normally report (next day) no dreaming. A few hours' delay often results in complete inability to report descriptively. Moreover, the functional balance of the sleeping organism is most easily disturbed. A sudden disturbance of the dreamer, which serves to awaken him, often breaks the continuity; he may then have no memory of dreaming. The use of intense stimulation is commonly avoided in the study of dreams. This particular tendency toward functional disruption is comparable with that found in waking life when a sudden emotional situation may not be properly integrated so that memorial losses of preceding things ensue. The most vivid dreams, in terms of description, seemingly occur when the individual is not so soundly asleep that he is unable to awaken without too much shock. Vividness then is partly dependent upon the depth of sleep, which in turn implies a dependence upon the level of brain functioning. This fact also accords with the peculiar vividness of hypnogogic objects about which we have previously spoken. Light morning sleep (after 5 A.M.) seemingly gives the best descriptive reports. This does not imply, however, that individuals fail to dream during other periods. Figure 84 shows the increased restlessness of the sleeper after this time. The individual is nearer waking here than at one- or two-hour periods after retiring.

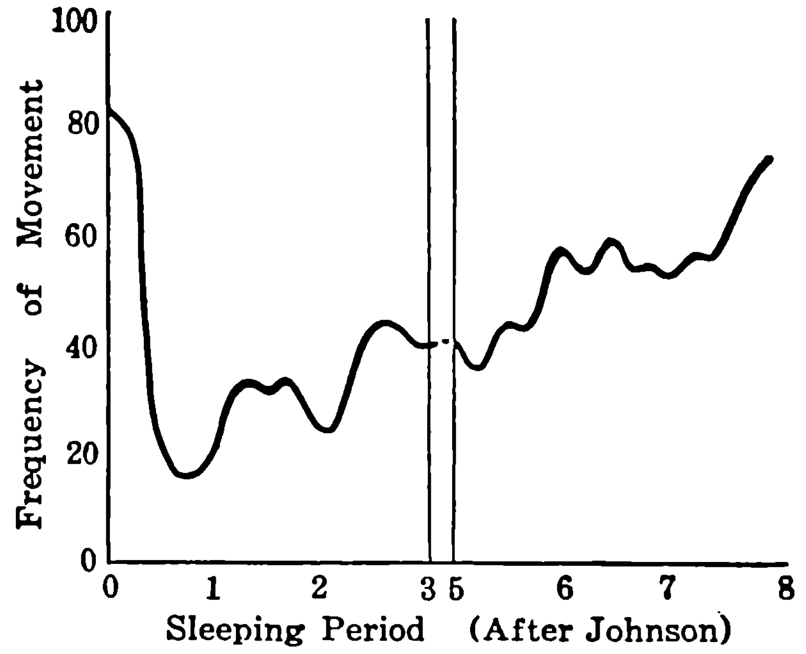

FIG. 84. The last hours are not the best in terms of quietness.

11. *Incongruity and Condensation in Dreaming.* The flow of dream situation is not always "smooth." Reports show that it may end very suddenly without observable cause. It may also change its direction without warning. It may show incongruities

about which nothing is often done — they are accepted without questioning. Last night, for instance, the writer dreamed that a friend came driving up in a vehicle pulled by a familiar cow. During our conversation the fine points of the cow were seriously discussed. To understand this apparent incongruity, we must realize that such products are imaginational. In dreams, an adult uses his imagination; but he does not know it. Like many cases in waking life, he has no way of discovering the fact. In certain respects he is wholly similar to the normal child, which must discover from the nature of life itself that certain objects from time to time possess properties different from those of other objects. The child makes this discovery in part through the aid of its perceptual environment. But the *adult dreamer* is usually lacking a perceptual basis which might serve to make him critical. When man observes something in imagination during his waking moments, he may possibly discover that it does not fit congruently into his perceptual environment. Even the eidetic child has no difficulty in differentiating its most vivid imaginational object from its perceptual objects.

At times, a waking individual may play or day-dream under conditions such that various possible incongruities actually do not exist. The imaginative child, for example, does not question the striking incongruities of the absurd situations in *Alice in Wonderland.* Thus waking imagination often shows no inconsistencies. For that matter, visual perception itself may at the moment show no inconsistencies as in the so-called illusion. The bent stick (in water) is not perceived to be inconsistent. It is only when one kind of product is related to another kind of product, that incongruities appear. It is not at all strange, therefore, to find an adult dreaming of horses crawling into rat holes, if one has a proper understanding of the psychological basis of such stories as *Alice in Wonderland.*

The inconsistency, the sudden ending, the quick shift and the confusion which appear from time to time are also due *in part* to the failure to remember. The situations of two or more dreams may partially merge or overlap when one tries to give a memorial report. Aside from frequency, the confusion here is similar to that of waking life. Again, one dream may theoretically *stop* and another may *start.* But there is no valid reason, aside from the rise and fall of sleeping level, to assume that the organism functions

in this stop-start manner.[1] We must assume that it is continuously functioning (especially in light sleep). But of such a period, there may be only "snatches" of reported dreams. When these are partly telescoped or laid end to end with much in-between material lacking, it is not surprising that we occasionally secure, particularly in the less vivid dreams, a striking pattern "which only a madman could have woven."

f. **Measurement of Imagination.** 1. *Ranking.* The measurement of imagination as a function must be made, as is true of *all* functions, in terms of its several products. These may be verbally described, drawn in pictures, or written in prose or poetry. In each case, the product can be rated or ranked by various individuals on some scale of excellence (values). Although we do not usually resort to any such systematic procedure, we do nevertheless rate various imaginational products as being good or not so good. Thus we frequently read a story which deals with an imaginational situation and praise it or condemn it. If the story is of such a nature that we are unable immediately to discover the solution, or if the plot moves ahead rapidly enough to sustain our expectation of what is coming, or if the descriptive objects are quite unusual, we may say that it is good. Any outstanding detective story clearly illustrates the first two points. Stories of the general nature of *Gulliver's Travels* or of *Rabelais* illustrate the third point. It is a simple matter, moreover, to ask a number of individuals to draw some object of their imagination and to submit these objects to a set of judges to be ranked in order of their imaginative originality.

Fig. 85. Rorschach figure.

2. *Rorschach Tests.* Another quantitative method of studying imagination makes use of the Rorschach tests. These concern the rate and the number of objects which emerge from some simple pattern such as the ink-blot shown in Fig. 85. Large differences appear among individuals in these tests. A study, for instance, was made of two groups — the one poetic and the other non-poetic.

[1] There may be gaps because of deep sleep. But the organism has no knowledge of such possible gaps.

The criterion of the first group was publication in some standard magazine or membership in a recognized poetry club. Within the same time limits, an average of fifty items was given by the first group while the second group gave twenty-seven.[1] About fifty per cent of the objects named by normal children and adults in these tests are animal and human beings. For some reason, subnormal individuals definitely tend to report animal forms. According to Rorschach, the percentage of such animal responses varies inversely with mental age. Feeble-minded groups range well above sixty per cent. These tests have also been used with individuals showing functional disturbances. But no clear diagnostic value has yet emerged from such studies. Gross departures from normal standards are very evident. But these variations are not specific to particular types of psychological diseases.

g. Explanation. We regard imagination as being a functional property of man. Viewed broadly, it cannot sensibly be considered as a purely biological mechanism whereby man adjusts himself to his physical and chemical environment. A superficial examination of such activities as play, day-dreaming, and dreams of sleep will reveal nothing to which an individual can possibly be said to adjust. Judged in terms of any practical service rendered man by his sleeping dreams, it would be much better to regard such as being a form of useless survival comparable in this respect to the grasping and clinging behavior on the one hand and to the appendix and other vestigial structures on the other hand.

1. *Causal Factors.* Imagination is in part an inherent characteristic whose limits are set by heredity. It is no more possible to give an *adequate* explanation of imagination in any other way than it is to explain many unlike inherent properties of physical and chemical substances. Strictly speaking, there is no supporting evidence for an assumption that the little child gradually acquires the ability to imagine through some method of trial-and-error *learning* or through *teaching* by other human beings. The child does not know for some little time that it possesses an imagination. By the time the child makes this discovery, it is well started on its functional development. If the average parents make any attempt to develop their child's imagination, it is surely not done intentionally. More often, in fact, parents say that their child possesses too much imagination. Although heredity unquestionably plays a

[1] Stumberg, D., "Study of Poetic Talent." *Jour. Exper. Psychol., 11.*

dominant rôle, the particular form which imagination assumes — the general character of the products — is definitely determined in part by the environment and the personal history of the individual. Certain individuals accordingly imagine certain objects while other individuals produce other objects. The individual is functionally dependent within limits upon the nature of the cultural and industrial *milieu* into which he is placed by birth. But even within the same limiting family group, one individual will produce in one way while another will produce in a different way.

Heredity contributes to man's functional performance. It is accordingly impossible to reduce the imaginational abilities of the musical or poetic prodigy, for example, to a particular describable form of environmental agency (of a physical or chemical sort) on the one hand, or to training, inspiration, or encouragement on the other hand. We well know that parents as well as teachers, content to leave nothing to chance, work diligently with their children. They seek *in every possible way* to encourage and to assist them in their attempts to *achieve greatly.* But their results in most cases seem quite trivial when compared with the extraordinary individual who does not need or who may actually lack such handling, yet who achieves greatly. It has been scientifically recognized since Galton made his memorable studies that some human beings are definitely characterized by their functional precocity. Such individuals appear surprisingly early in the absence of evident training; and they tend to push forward despite what often appear to be unfavorable conditions. The excellent studies of Terman have also contributed significantly to our knowledge and understanding of the superiority of the precocious.

2. *Appearance and Development of Imagination.* Imagination appears during the early years of the individual's life. It gradually emerges, as a distinct *functional* property, out of the undifferentiated mass activities of the individual. Theoretically speaking, its "first" stages are unknown. They cannot be distinguished from those of perception. This fact further enables us to understand the tendency, even of the adult, toward confusion of the two kinds of products. As playful behavior gradually comes to involve environmental objects, evidence of imagination also appears. Stones, sticks, pieces of wood, bits of clothing now possess new meaningful properties. They become dolls, guns, horses, dishes, trains, birds — in short, whatever object may be *perceived* in the

child's environment. For a few years the individual plays with fairly simple objects. During this time, there is every reason to assume that as a result of imagination such objects take on properties common to other things. An ordinary stick may accordingly do service over a long period in many unlike situations. But at all times, *there is an object* — either a particular object or an object which belongs to a class. When any one of these several significant properties disappears, a stick which may possibly have been many things may now be cast aside or destroyed. But, as long as one of these properties remains, to remove (or break) the stick may seriously disturb the playful *situation* with consequent disturbances in the child. It may strenuously resist the removal of its mother, its horse, or its wagon.

3. *Imaginational* vs. *Physical Objects.* It is quite evident, even in the very beginning, that the individual always deals by way of imagination *with objects.* As it begins, so does it continue. As an adult, his way is unquestionably more efficient from an industrial, literary, political, or scientific point of view. He is able to take many different objects and relate them so as to contribute to society in a variety of ways. He can also construct some plan — literary, scientific, musical — which involves a large number of related things. We recognize that an object may be minutely described at first in imaginational form and then carefully worked out at last in perceptual form. We must warn the student here against confusing psychology and physics. Psychologically speaking, a great dam, for instance, may actually exist in minute detail before the ground is broken or one pound of cement is poured. Psychologically speaking, it thus has as much existence as any dam can ever have, even when it is perceived. By moving from imagination to perception, one does not pass from unreality to reality. All psychological properties belong to the same order. All physical properties belong to another order. But both classes of properties may deal with the same object. A thing may be common, but its properties may differ. As a matter of fact, if a dam during the process of its physical construction should be changed by another individual so that it failed to accord with the dam as originally planned, the chances are good that the product of imagination (thinking) would win. We do not imply that imagination is infallible. Various changes are often made when man discovers that his imagination — planning — has been inadequate. Here subse-

quent experience reveals the inadequacy of earlier experience. But fallibility is no measure of reality. Man, regardless of how he may be taken, is not omniscient. To imagine is not to know all. Students sometimes assume that because imagination does not always *produce* a perfect product that it somehow deals with things which have no valid claim to existence. Nothing could be farther from the truth. In general, imagination always produces something which is meaningful. The nature of what is produced may vary enormously. But it is always new or different in one or more respects.

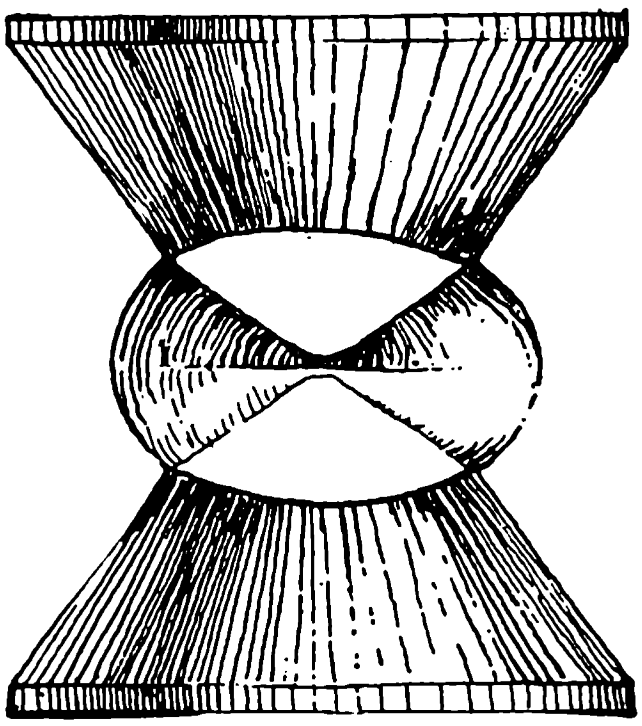

FIG. 86. An imaginational object.

4. *The Objects Are Novel.* The new unquestionably emerges from time to time. New objects with old properties, or old objects with new properties appear. Should the student have difficulty here, let him draw some imaginary object and then regard its various properties. Or, let him regard in this connection the objects which are shown in Figs. 86 and 87. Here is a sketch (86) of a helicoid and of a rectilinear object (87) which belong to the mathematical department of the University of Illinois. These are purely imaginational; yet they find useful service in mathematics. These objects are no more *mental*, of course, than any other object which the student ever perceived. The shape, form, and relations are psychological. The criterion of existence must not be put solely in terms of physics and chemistry. The failure to clothe an imaginational object in physical guise in no way impairs the nature of the object. No man, for example, has ever shaped a physical object without the constant guidance of such psychological functions as perception and imagination. Every object with which man deals in this way has describable psychological properties. It is, in short, a psychological as well as physical and chemical object. Coolidge,

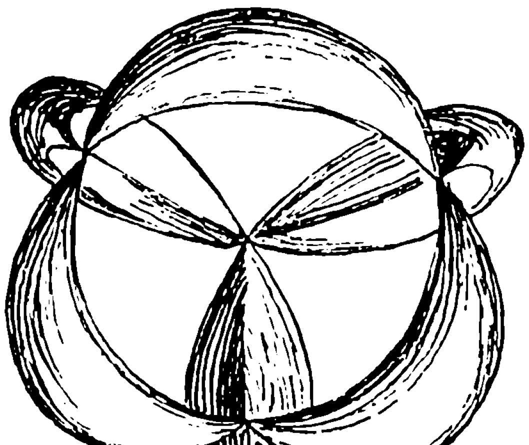

FIG. 87. A mathematical object produced through imagination.

for example, sat for many different portraits. Each portrayal is unique. Some show him to be genial; others show him to be stern. He apparently preferred one above all others because of the nature of the mouth which the particular artist gave him.

5. *Discovery of Imagination.* The child does not observe that it possesses an imagination and that, as a result, certain situations are imaginary. The adult, moreover, does not observe his imagination — no more than he observes his hereditary or digestive functions. Both child and adult observe certain objects. Either may possibly discover in several different ways that a particular object does not fit properly into a total situation. When this time arrives, the individual has become critical. The adult, however, may not be critical in either his sleeping or his waking dreams. In the former, his possibly perceptual environment may be entirely absent. Yet the various objects of dream situations come and go. Psychologically speaking, these dream objects are all that he actually "possesses" at the moment. If they were to go, he would be psychologically bankrupt. A similar condition exists in the ordinary day-dreamer. His perceptible environment may be largely — if not wholly — absent. The simple fact that an individual, while day-dreaming, may possibly be struck down by a moving object should serve to make our point more understandable. The individual may abruptly return from the environment of his day-dreaming to the environment of his perceiving. The startle or the momentary delay (confusion) which is often apparent in this transition also points the way to a better understanding. When an individual cannot easily return or cannot "stay put" for a reasonable period when he does return, an abnormal condition is to be assumed.

6. *Functional Integration.* Nature has equipped man with an imagination; but it has seemingly failed to give him any native criterion or test of it. He has accordingly to learn to distinguish among his several psychological products. He is forced to discover which are perceptual, or memorial, or imaginational. It is not strange, therefore, that many individuals may live normal lives, yet occasionally fail, for example, to differentiate perceptual from imaginational products. It would perhaps be even strange, in a highly integrated organism, if such complete differentiation always existed. As a matter of fact, we do not expect to find it among little children. But we do look for it among adults. In terms of

such expectation, we actually establish one criterion of abnormality. And we then discover that many persons are really peculiar inasmuch as certain objects (of their imagination) appear to them to be no different from other objects (of their perception).

7. *The Rôle of Cortical Functions.* The particular nature of the brain condition which must exist in order to cause certain persons to dream or imagine more clearly than they *theoretically* should is quite unknown. We assume, of course, that the *cortical* conditions which make it possible for an individual to perceive an object also make it possible in part for him to imagine the same object either singly or together with other objects. We have said that when man's brain is electrically stimulated many types of psychological objects may be directly produced. We have definitely assumed that similar changes go on continuously *without such stimulation.* The ebb and flow of the blood, the delicate changes attendant upon assimilation and growth, the changes in blood and lymph pressure, the inherent nature of the brain to function continuously, the constant shift in the chemical constitution of the body, the increases and decreases in glandular products — all such factors among others stand as the physiological factors contributing to imagination. In addition, there is the matter of functional preparation. The individual may instruct himself to imagine some particular thing, and meanings immediately flow around it. Other individuals may also affect him in this way. Or, the total situation in which he may find himself may contribute greatly. The normal person who awakens late at night, when everything around him is quiet, to resume some train of imagination; the long stretches of imagination reported by persons who pass through periods of general paralysis and almost complete helplessness; and the extended flights of imagination of blind and deaf persons, such as Helen Keller, during the momentary absence of any discoverable form of *organic* or *environmental* stimulation — all such cases lead us to assume *that cortical functions sustain themselves.* Here is a unique characteristic of life so far as it concerns neural functioning. But it is not so very different, however, from the case of many chemical substances (consider radium) of which we can say that it is their very nature to change continuously.

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OUTLINE

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CHAPTER XV

THINKING

A. *Introduction*

We have now reviewed, both descriptively and explanatorily, certain functional properties of man which reveal themselves in part by the nature of their products. Man deals psychologically in several ways with the observed objects of the world — objects, such as human beings or books, which may be perceived or remembered or imagined. Thus objects appear under dissimilar functional conditions and possess various characteristics of which some are alike and some are different. Among others, such properties as shape, color, familiarity, location, and class may possibly be identical, although each may vary, within limits, depending upon whether it is perceived, remembered, or imagined. In every case, a meaningful characteristic or property of an *object* or *situation* is always produced. Man does not produce ideas, if such are regarded as being bits or portions of his mind which exist independently of objects. Properly considered, they are not mental things which may be *revived* in memory or *created* in imagination. They are not to be regarded as things which are retained in some way in the human mind and which may be brought up from time to time for purposes of inspection, examination, and recombination. We are not concerned, therefore, with questions of this general type: When we remember an object, is the *idea* that comes to consciousness the *same* — or different — idea that we had when we thought of it on former occasions? Implied in this question is a particular kind of agency in which we have no scientific interest. On the contrary, we are concerned with such questions as: What kinds or how many kinds of objects is an individual now able to describe in terms of their various properties *observable* under a particular set of causal conditions? Here is an approach that may be fruitfully followed. As a matter of fact, we find that whenever an individual remembers or imagines, an object is directly describable. An

individual may accordingly say, "Oh! I had forgotten that I left my car there," or, "I just remembered that my physician told me to call him today," or, "I can imagine the state of my car tomorrow when I return from hunting." Meaningful objects of the world are repeatedly revived or imagined, but not sensations, mental images, or mental ideas. The objects may be either human (perhaps the functioning individual himself) or non-human.

B. *Understanding as a Form of Thinking*

a. Some Distinctions. There is, however, another way in which man may possibly deal with many things of the world. Man may be directly related to the objects comprising life situations by way of thinking. We include two slightly different forms of functioning under this head, *namely*, understanding and reasoning. Each is in part non-perceptual, non-memorial, and non-imaginational. At times when an individual sits in reverie or when he remembers or when he works out a plan in imagination, he may remark that he is "thinking." We hear people remark, "I think it is time to go," "I think all the students are industrious," or, "I think my car is better than his." In these cases, the word "believe" can also be properly substituted for "think" without changing the significance of the situation. Loosely speaking, we "think about" or "think of" many objects when memory and imagination are clearly implied or when a belief or an opinion may be held. Thus it can be said: "I think that he is good," "I believe that he is good," or "In my opinion, he is good."

Man understands many objects and situations. Here is in fact a way of dealing with objects which finds very wide service. Literally speaking, man actually understands thousands of objects or situations before he reasons out a single one. The student should realize that little children, for example, may think about many things before they may critically question a single one. When they do raise questions about objects and situations, it is to their understanding — not to their reasoning — that adults commonly appeal. We have repeatedly used this term in the preceding chapters. We shall now consider it in detail. We point out that when an individual deals understandingly with a situation, he functions in such a way as to produce unique characteristics. An object which is understood is different from one which is not understood. It possesses significant properties which do not

appear in the absence of understanding. Understanding a situation depends upon the emergence of particular meanings. The individual who understands is able to act in a decidedly different manner from one who does not understand. To understand is to do more than perceive, remember, or imagine.

b. Nature of Understanding. In understanding, man deals with a thing in terms of its relations with other things. We accordingly understand the breeding of animals, the causes of diseases, the speech of our friends, and the danger of fast driving. We also understand such very ordinary characteristics as movement, height, time, taste, or beauty of objects. Again, the plot of a detective story or the various relations of one part of a machine to another are meanings which we understand. Or, we may possibly read a mathematical problem and understand it (although we may not be able to find a *solution*). The functional products of man, as far as his understanding is concerned, are commonly characterized by certain *relational properties*. An individual may perceive smooth rocks on a beach, which he understands in terms of their relations to something else — for example, water. Similarly, relationships are implied when we say that we understand the drifting of dry snow, the return of the seasons, the digestion of food, the perception of distance, electricity, the attraction of one body for another, mathematical formulae, and emotional outbursts. Relationship is definitely involved in our understanding of a tool which necessarily possesses a unique property by virtue of its particularized use. Language, too, is really a tool which does valuable service in understanding. Man uses it to achieve a desired end. Strictly speaking, language is a functional product that serves to instruct and to assist man by way of his understanding. Generally speaking, understanding is an activity that touches a great variety of life situations. It is a mode which is involved when an individual remarks that he is aware of what is expected of him, or that he knows what he (or some other thing) can or cannot do. To the extent that he *realizes* such ordinary relationships, man understands.

c. Significance. Understanding obviously represents a very important way of dealing with things. We cannot, however, say it is the most important. We have no way of reliably establishing a hierarchy of functions; for it is quite impossible to arrange (order) man's various functional characteristics according to some final

scale of values. The particular situation which he happens to face at the moment must always be considered. That is, if a situation now demands perception rather than memory, or understanding rather than action, we may safely evaluate the several unlike modes. An evaluation might also be possible if it could be adequately shown that some *one* functional mode is demanded more *often* than another. In general, we suggest that whatever furthers an individual's happiness and satisfaction must be important. Understanding contributes much in this way. Life may possibly run its course largely below the level of understanding, as in the idiot and in many animal forms. But a life that is lacking, for instance, in an understanding of simple tools (and speech) must necessarily be mainly vegetative. Only the very simplest relationships appear to emerge at the lower range of intelligence. Between this and the upper range, lies a vast territory when measured in terms of degree of understanding.

d. Education and Training. Education and training are concerned to a major degree with the task of determining understanding. Developing individuals are variously encouraged to observe widely and accurately in the expectation that their understanding will thereby be affected. They are directly urged to relate facts and principles as precisely as possible — to bring diverse properties or objects into organized wholes. Their understanding grows. Life demands that they meet and deal understandingly with objects in particular situations. Whether in school or in industry, in work or in play, the emphasis is always upon greater understanding. A premium is set upon increased grasp of relationships. In cases of extreme specialization, it would appear that society definitely encourages men at times to understand more and more. In science, for instance, an individual may spend the best years of his life upon the problem of understanding one form of animal or plant. Men have devoted years to the investigation of a few properties of one chemical substance such as an ordinary dye. The student of laboratory sciences is acquainted with the various devices commonly employed in increasing understanding of an object of study. He knows that the beginner is often given a set of instructions (questions) to be closely followed. This method is of material assistance in aiding him to observe and to understand the various properties of the thing. The major *value of the questions* in this case, as elsewhere, apparently lies in causing an individual to

observe understandingly — to fix particular relationships. Understanding proceeds in part by adding new properties to old to enlarge (or change) previous relationships and in part by establishing new relationships among old properties or objects.

e. Development. The growth of understanding constitutes an outstanding way in which human beings grow psychologically. Individuals differ greatly in terms of their ability to grasp relationships — to regard a situation in terms of a particular characteristic or feature which lends unique relational significance to it. Such differences are found at all post-infantile age levels. Understanding appears early in the normal individual; but the exact time and the actual origin are quite obscure. We assume, however, that its roots actually reach back to the simple form of "abstraction" which we referred to as existing from the very first moments of an individual's life. The normal infant, we have said, observes certain properties of environmental objects (and itself) from the very beginning. We find no scientific reason to assume that such psychological properties as sweetness and sourness, or warmth and coldness of many objects ever *change* to any significant degree with increased maturity unless, of course, disease or functional impairment appears, or unless the objects change with respect to some of their physical or chemical properties. These meaningful (psychological) characteristics, as well as many others, are observable *from the beginning.* Thus the very young child actually possesses a partial basis for a later understanding of various things. Its psychological functions do not remain inoperative for a month and then suddenly start up as a machine may do when a controlling switch is thrown. It observes at birth and it continues to observe throughout its lifetime. Moreover, it observes objects at birth *in terms of a few of their properties.* Under normal conditions of development and growth, as it later finds occasions to observe other properties of these same (or different) things, its understanding of such things gradually increases. It has merely to relate various properties to secure a degree of understanding.

The child starts simply in this respect, it is true, but it normally goes far before the end. The extent is in part dependent here, as we have seen in perception, memory, and imagination, upon the environment — at least, as far as it prepares or instructs the individual or furnishes occasions for understanding. We must grant, however, that training alone cannot significantly increase or im-

prove man's capacity for understanding. For instance, no one through intensive training can induce a normal degree of comprehension in a feeble-minded individual. Individuals of normal intelligence who are properly instructed show varying degrees. One who shows a relatively high degree in one direction, when measured in terms of his functional products, may fail to show a corresponding degree in another field. We accordingly find individuals who are unable, for example, under the usual classroom conditions to understand algebra or calculus. We cannot sensibly contend therefore that all individuals who fail in mathematics do so because of sheer perversity, indifference, or lack of study. No thoughtful person would indiscriminately recommend that a majority of all college students register for courses in higher mathematics. Many students who are apparently capable of doing general college work do not possess sufficient understanding of mathematics to enable them to compete successfully with the small percentage who do have this understanding. There is no reason, moreover, to assume that all who fail could really be successfully trained to achieve. Many apparently lack mathematical ability.

f. The Relation of Other Functions to Understanding. The function of understanding, either of one property common to many objects within a prescribed area, such as the height of American men, or of several properties of one object, such as the area of leaf surface and the amount of water consumed and the growth of a tree, is intimately related to other functions. It seemingly feeds upon the products of perception, memory, and imagination. As is true of the other psychological functions, man's understanding is not wholly self-sustaining; it is not completely independent. The organism is a unity; but it has diverse functions. Each is normally related to others. Let us assume, for example, that we are set the particular task of understanding human beings in terms of their height. We accordingly proceed to perceive widely among unlike racial stocks and under various environmental conditions. We may also note how height varies with sex and age. Before we finish we shall most likely draw upon our memory of what other men have contributed. We may also further our understanding by imagining changes produced in height under conditions of selective breeding, through evolution, or by controlled diet. By relating height in this way to stock, physical agents, and diet, we

add to our understanding of human groups in terms of this one property. Through seeing, hearing, tasting, smelling, and feeling man partly secures the various materials involved in understanding. Later we shall point out that man also reasons out solutions to problems and makes discoveries, thereby adding to his understanding.

g. The Rôle of Language in Understanding. Language is a tool universally used among human beings to further understanding. It enables one individual to give another an accurate description of the various properties of an object. The relation of things to each other may be directly pointed out. Through it, an individual may be properly instructed to observe a particular situation in such a way as to grasp the way one thing bears upon another. For instance, the surgeon in the clinic during an operation discusses the proper technique, points out the things to be looked for, and cautions his listeners about other things. Lacking such discourse, the procedure definitely tends to be less meaningful. Similarly the value of field excursions, exhibits, and class demonstrations is definitely enhanced by pertinent comments by one who possesses proper knowledge. The primary functional demand laid upon the student in the class demonstration is one of understanding. He is seldom called upon to reason out various relationships. The instructor himself may or may not do the reasoning. More often he does not. In the laboratory, for instance, several possible properties of some object may be changed (for example, temperature) and resulting changes in other properties may be noted.

Illustration from Human and Subhuman Levels. The peculiar value of language for understanding becomes quite evident in experimental work with human beings and with animals where a specific task is necessarily involved. The human being may be precisely prepared for effective participation by a spoken or written statement concerning what is expected of him. Where such understanding is lacking or where the instructions are misunderstood, the results obtained from any human subject may be greatly impaired or wholly valueless. The animal, which of course cannot be instructed in this manner, is placed in the experimental situation where in most cases it must be depended upon to discover what is expected of it. Under such conditions, it is not surprising to find many which fail in particular situations. Human beings might also encounter considerable difficulty in falling easily into the plans of the experimenter if they were similarly placed.

Yerkes, for example, has pointed out that one large ape may produce the proper solution to a particular problem more readily than do many others. Yet perhaps when placed on another problem, the same ape may possibly fail where others quickly succeed. An animal may repeatedly proceed in a certain manner and thereby secure food, although there may be more desirable ways — in terms of the experimental situation — in which it could be obtained. An ape which shows such persistence may accordingly seem to be rather stupid. The situational task for the ape concerns the satisfaction to be derived. Lacking the possibility of an understanding that is determined in part through language, the ape in order to meet the experimental situation must often become *dissatisfied* under one mode of attack, even though it may actually give him satisfaction, in order to seek another. Often when pressed too hard to make such shifts, it either attacks the experimenter or refuses to proceed further upon the problem.

In closing this phase of our discussion, we must raise the question of subhuman speech. Since the large apes stand functionally closer to man than do any other organisms in the entire scale of animal life, we might legitimately expect to discover in them the rudiments of language as such is found in man. For an answer we can turn to no more reliable source than Yerkes. Of this particular matter, he remarks that an ape can readily be trained to speak for food. It does this, however, not in any *imitation* of the trainer, but to secure food. It speaks in response (just as a dog comes to bark) to certain sounds around it or to the various *situations* which they accompany. It does not acquire or introduce new vocal sounds. Speech which has any human characteristics is totally absent at this level of life. We regard speech as actually representing an emergent functional characteristic of human stock.

h. Reading. Many studies have been made upon problems of reading and understanding. A poor reader may be defined in part as one who is less able to understand. A good reader is one who is more able to understand. Various methods of attacking this particular problem of understanding have been used. For example, paragraphs of equal difficulty, each containing an absurd phrase, may be given individuals to read. To be graded as correct, the phrase must be understood and crossed out. Or, paragraphs of unlike (increasing) difficulty may be given. A number of questions are then given concerning the material read. A comparative

measure of understanding as it is concerned in reading may be secured in this manner. Using such methods, norms have been determined for various educational levels. The Minnesota Reading Tests, for instance, give the following values: For understanding, university seniors give a median score of 18 points as against 15 points for high school seniors. On speed of reading, university seniors show a median score of 22 points as against 18 points for high school seniors. This does not necessarily mean, however, that any great improvement occurs between the senior year in high school and the senior year in college. This difference in test scores may very well be attributed to the selection of students, if we may rightfully assume that the colleges attract the better high school seniors.

Another method of study here concerns the actual eye movements involved in reading. In reading ordinary material, for instance,

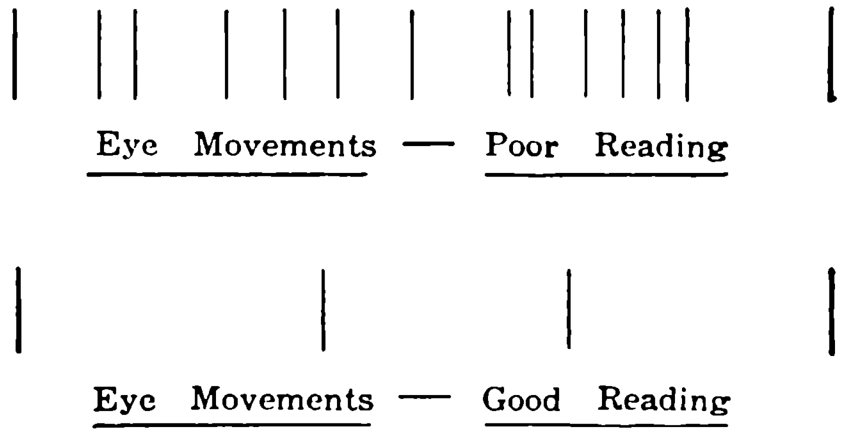

FIG. 88. Individuals show great differences in eye movement.

the poor reader tends to show more pauses and to make more regressions (turning back) than is true of the good reader (see Fig. 88). These eye movements are commonly studied by throwing a beam of light upon the cornea or by placing a particle of Chinese white upon the eye. The eye may then be photographed with a motion picture camera. The total number as well as the total time of the pauses varies greatly with the type of material. With ordinary fiction, one set of values has been obtained. With scientific material, however, a totally different set is secured. In the latter case, the period of pauses given in terms of percentage of time may be fifteen times greater than the period of movement. Many regressions may also occur with such materials. But those of the poorer reader will still be greater than for the better reader. In connection with such studies, it is sometimes reported that *nothing* is observed during the period of eye-movement. We recognize, however, that one does not observe nothing; nor for that matter is there ever a

moment when one is not observing. If the eyes, for instance, move too rapidly, one still observes but one does not understand the words.

i. Insight. In many cases, understanding in particular situations may proceed quite gradually, as every student knows from his ordinary experiences as he reads and listens. But at times under certain conditions, as when he finds himself in a baffling situation, the course may change. To use a gross analogy, it is as if energy were definitely restrained for a time and then suddenly released. When the situation is favorable, the individual seems actually to advance by leaps and bounds. Every student has no doubt observed the way in which a particular meaning may suddenly emerge as he follows some discussion. The speaker talks along. What he says has meaning, but it is not of the right sort; it does not relate. As the slangy student remarks, "it does not click." Unable to discover the desired relevancy, the student may possibly inquire of another "What is he talking about?" Or, on the other hand, he may just wait. Then quite suddenly he may "see the point." From the various materials given by the speaker, there has now emerged a new meaning. Everything now "makes sense." The new characteristic or functional product may be very different in many ways from the actual materials given by the lecturer. The described object or situation now bears a kind of significance which may have been completely lacking a moment previously. This is essentially a product of the total situation; it is a striking form of thinking.

A simple form of thinking seemingly appears at times at the animal level. The evidence indicates that such understanding must proceed in the absence of knowledge; that is, it has a non-factual basis. The animal which "sees through" a situation cannot be said to be dealing selectively with factual materials. Such non-factual functioning is also common among little children as well as normal adults. These meanings may often emerge without any extended hesistancy or searching. An individual, for instance, may consider various objects or characteristics of a total situation in terms of a particular problem. His scrutiny in this case may be compared with that found in the case of the individual who turns a piece of jig-saw puzzle around in his hand to view it from different angles in his search for the missing piece. A piece may be quickly accepted or as quickly rejected. The desired object, however, may

be *repeatedly* passed by. But again, it may suddenly be perceived to fit properly into the situation. The meaning, as in this illustration, does not arise in any piecemeal fashion; nor does it in other cases. It is seemingly an all-or-none matter. An individual either does or does not grasp the situational relation. The meaning may possibly be different from what another individual may expect; it may, in this sense, be judged to be wrong. But it apparently arises directly as an unitary functional product.

1. *Among Animals.*[1] Some excellent studies have been made, upon the ability of animals to produce changes in behavior which, in terms of their suddenness, are quite like those changes which come at times in the case of man when he understands. In an experiment with anthropoid apes, Koehler placed a banana outside the animal's cage which was constructed of uprights with enough space between to permit the arms of the ape to be extended. A stick sufficiently long to reach the fruit was then placed inside the cage and in such a position that both food and stick lay within the visual field of the ape. Under these conditions, the ape would seize the stick and drag in the food. When the stick was placed so that it fell outside the visual field of the animal when it perceived the banana, functional integration of the two objects required more time (was more difficult). Under the need for food, however, the ape finally succeeded in relating the two objects. The tool meaning in this case was later extended to include even a blanket. Under other experimental conditions, the ape came to use a short stick to drag in a longer stick by which it secured food.

Again, the ape was given two sticks, each of which was too short to secure food. Joined together, however, they were long enough. The hungry ape repeatedly tried to obtain food with these sticks, but without success. This fruitless work finally ended. The ape sat down and appeared to play with the sticks. During this manipulation they chanced to fall in line with each other. The ape thrust the one into the hollow end of the other. Instead now of continuing his play, the ape ran toward the food and pulled it within reach. In still other experimental situations, food was suspended above the animals at a height such that it was necessary for them to stand on boxes in order to reach it. The boxes were

[1] In this connection, we refer the student to careful studies of Tolman and his students (*University of Calif. Pub.*), by Maier, by Wolfe, and by Reynolds with rats.

scattered around the enclosure. The use of one or two boxes to secure the food was relatively easy; but the use of three boxes as shown in Fig. 89 was difficult.

2. *Among Human Beings.* (a) *Non-factual functioning.* Experimental work of a nature similar to that done with apes has been done with normal and subnormal children. They have been placed in situations where the use of sticks (both short and long), or a box, or a chair, or a combination of these was necessary in order to obtain a coveted object. Some children could solve some of these but not others. A few seemed unable to do much with any situation. It was evident in those cases where the object was obtained by meeting the conditions of the experiment, that understanding came at once as a unitary product. The children would sometimes exclaim at the very moment that the new meaning — relational property — emerged. At other times, there were merely changes in the facial expression or in the nature of the movements (change in direction or in speed) of the individual. In experimental studies of adult individuals who are asked, for example, to work puzzles, subjects repeatedly report sudden flashes of understanding. They report that the simple puzzle is "transformed"; it becomes "clear" and "understandable." In many cases, this new meaning came early in the attack; in other cases, it appeared much later. Some individuals encountered much more difficulty than did others. Ruger, for instance, tends to emphasize a preliminary period in which random hit-and-miss efforts may appear in understanding mechanical wire puzzles. Since these efforts may be cut very short in certain cases and greatly prolonged in others, the exact nature of their contribution to the sudden emergence of a new meaning remains in doubt. It is impossible in fact to show that they have any significant (necessary) effect upon the final outcome.

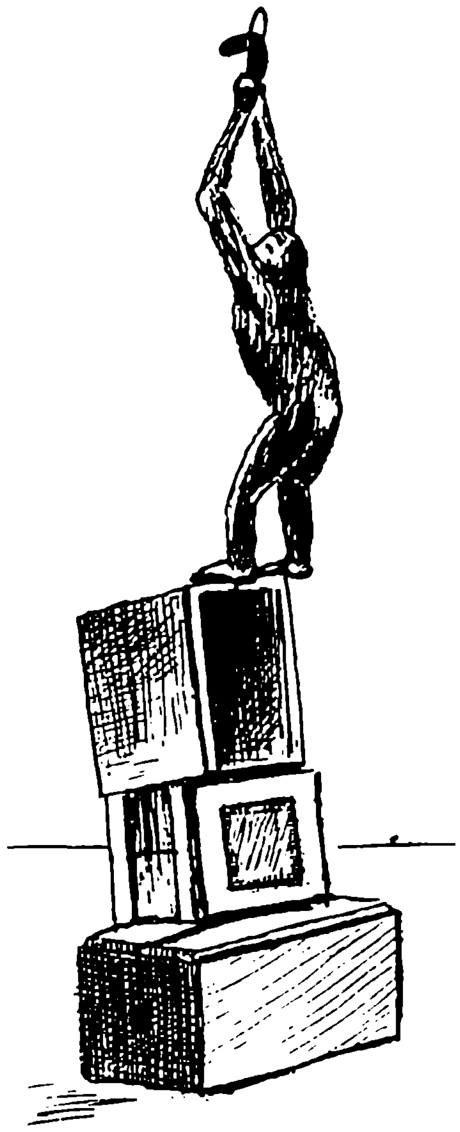

Fig. 89. An ape builds and so achieves satisfaction.

(b) *Understanding with facts.* A striking illustration of insight may be drawn from the life of Kettering, who produced and per-

fected the electric starter, ignition, and lighting systems for automobiles. He had agreed, he reports, to furnish the Cadillac Company with a satisfactory ignition system. His allotted time was about up. He got all his coils together. One after another he wired them up to dry batteries and to an adjustable spark gap (to take the place of the actual spark plugs in an automobile). All morning he tested. Over noon he tinkered. All afternoon he experimented and fiddled. It grew dark and there he sat woolgathering, tinkering, doing over what he had *done a hundred times already*, and getting absolutely nowhere. The coils must be all right. There were no better coils. Tomorrow the company must have new coils. It was lonely in the hayloft of the barn as he sat twiddling, fooling, fiddling with no definitely formulated plan of investigation — his hands tinkering while his head failed him, trying this and that and everything over with his tired fingers. There were no better coils and the train left Dayton a little after midnight. There! What happened to that spark? Wait!

(1) In Invention. He had been fooling with the adjustable spark gap. He had set the point close to the strip. The spark was fat and healthy. He twiddled the screw. The gap was now a little wider, and suddenly the spark fizzled out, leaving only a wee blue lightning — a corona — at the point. He idly turned the screw to make the gap still wider. There! Again the spark appeared, fat and healthy! "Again and again the same strange business, and then, like a flash, he saw it."

"He jumped up, and with fingers maybe just shaking a little, he performed the absolutely simple operation of switching the two wires leading from the dry batteries so that the negative instead of the positive led to the contact point. Then once more the test. And sure! He laughed." He jumped up and caught the midnight train leaving Dayton for Detroit.[1]

(2) In Laboratory. In certain respects this method of attack is similar to that to be found in laboratory studies of thinking. In commenting upon the subjects who attempt to solve a problem which involves doing something to objects in a situation, Bulbrook points out that the subject commonly formulates a method of approach. When his approaches all fail him, he ceases to try and desires to terminate the experimental period. He does not continue, trying at random, in expectation that the solution will

[1] *Sat. Eve. Post.*

simply occur. He applies a definite method; and this method is his own contribution under self-instruction. He does not simply wait for the sudden appearance of the solution. He normally does something that definitely brings about, or causes, or creates the new meaning.[1] In Fig. 90 we give a simple object and situation

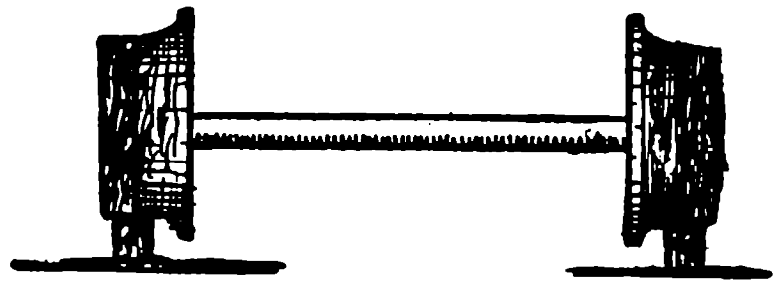

FIG. 90. Can you solve this problem?

which the student may attack by way of thinking. Let him consider, for instance, this matter: When a locomotive goes around a curve why isn't the wheel on the *outside* rail (of the curve) forced to slide slightly along the rails in order to cover the greater distance? Let him observe the manner in which the necessary relation appears in this case. This situation may possibly involve reasoning — a form of thinking which we now wish to consider.

C. *Reasoning*

We come now to a slightly different form of thinking. This type of function is to be differentiated from understanding in terms of the nature of the product. We say that we ordinarily understand a murder, the seasonal changes, the failure of our bank, or the mechanism of a gas engine. We can accordingly follow the mechanic, for example, as he shows us how the vaporized gasoline flows into the cylinders, how the distributor moves around to permit the electricity to leap across the spark gap, and how the expansion of the gases ignited by the electric spark forces the pistons to move. In this, as in many cases of understanding, there is essentially one outstanding feature, *namely*, the patterning of various facts. The final stage of understanding commonly seems to wait upon one particular fact that clears the situation by integrating the various features into one whole bearing a characteristic meaning. The emergence of meaning in understanding often depends therefore upon a particular thing which, in another situation, might possibly be regarded as being trivial or unimportant.

[1] "An Experimental Inquiry into the Existence and Nature of Insight." *Amer. Jour. Psychol.*, *44*.

One does not necessarily need, for example, to reason out the mechanism of a gas engine. He may readily understand it merely by hearing it discussed by another. But the gas engine was originally thought out. It is in part a product of reasoning. Simply stated, it represents the expression in physical form of a psychological object. Its *original* dimensions — characteristics — were psychological; they were functional products. Psychologically speaking, its pistons, for instance, moved before they were finally cast in physical form. When they were at last *perceived* to move, they were merely fulfilling *in perception* what they had previously done *in thinking* and *in imagination.* If the perceived movement, for instance, had actually been different from the thought out movement, more thinking would most likely have followed upon this particular problem. Let us briefly consider the nature of this reasoning.

a. Nature of Reasoning. There is always a definite task or problem involving an object or total situation. The task may vary greatly, but it always concerns the satisfaction of a need. The need may concern curiosity or a practical end. We may reason out the weather for the next few days, the effect of public ownership upon railroads, a way of getting a stronger spark in our car, a method of going home without paying car-fare, an effective prevention against juvenile delinquency, or a satisfactory method of reviving asphyxiated individuals. In each of these cases, new meaning emerges; some thing is accordingly changed. The particular solution or discovery is always original for the thinker. In each case, an individual seeks a particular end and is baffled. Necessary objects or properties (relational) are perhaps missing. Or, perhaps, some facts about a particular situation are conflictory. The individual may then seek to relate them by discovering a characteristic or property or factor common to all.

We do not assume that necessity is the mother of thinking, unless necessity is regarded as being *the same as determination.* Economic necessity, for instance, has nothing directly to do with many cases of reasoning. But thinking is always determined. Some individuals, for example, are not satisfied until they have related or explained many things which ordinarily bother very few men. Caldwell, an instructor of Kettering (Ohio State), is reported as having said that the latter was always asking him questions about electrical matters that he had never even heard of. He was always

raising problems about electrical relationships and then trying to solve them. "Necessity" in this case was his desire to know. We suggest, therefore, that some individuals seemingly find contradictions and difficulties and baffling situations where other men do not. Two men may face the same set of facts about a particular situation. One may think, and the other may not. The one may create; the other may not.

There is one end only in each thought-situation. It is definitely determined in the formulated task. There can be no reasoning when the particular end is not clearly defined in the problem. That is, the solution, which involves a relational characteristic (one thing in relation to another thing), must be an integral feature of the task. It must be discovered, therefore, without going beyond the problematical situation. Since thinking in each case has to do with particular relationships, to go beyond a given situation would involve the organism in new problems and relations. The nature of this form of thinking may be clearly illustrated by regarding the matter of choice. Thinking is not simply choosing one thing in preference to another. One accordingly does not reason out such an alternative situation as this: "Shall I study medicine or law?" In this case, one may possibly gather many facts about each profession and then decide in the light of these facts. He makes no discovery; the search really resolves itself into a simple quest for conviction or support. Reasoning as we consider it is quite different from the selection of one of several possibly known ways of securing satisfaction — of reaching an end. We have said that the foot-ball captain does not commonly think out solutions while on the gridiron. We also suggest that the student, who for instance has learned four different rules which are possibly appropriate to a particular problem, does not think out the solution when he successfully applies one of them to the problem. He may recognize the type and apply the rule just as the physician may immediately recognize a case of eye-strain and advise rest although no reasoning is demanded or occurs.

The discovery of Neptune furnishes a striking illustration of this matter of thinking. It was known, for instance, that the planet Uranus was slightly different at certain times from what it was at other times. Here was an *object* that showed certain changes in its observable properties at definitely determinable times. The task

then appears: Why does Uranus show these particular changes in its rate and its direction of movement? Here, the thinker was in the open where no one of a given number of set *rules* would apply. Various facts about Uranus were well known by certain scientists; but no one fact was adequate. The search was accordingly for a "relationship" which would integrate these several facts and make each meaningful for all. Out of a knowledge of these properties of Uranus, there finally issued the discovery of Neptune. After Neptune was discovered, it was quite evident that these facts were necessary. The solution, strictly speaking, issued from all. It should accordingly appear that, in thinking, one fact cannot work without other factual meanings. The "last" meaning, however, may be very important because it permits the new objects or properties to come out. To cite a rough analogy, no one building block is actually more important than another in the construction of an arch. All are quite necessary. But when the key-stone goes into place, a totally new thing with new properties appears. The "arch" which a moment before would not support its own weight may now support tons.

b. Place of Reasoning among Man's Functions. Reasoning necessarily involves rigid selection of relevant data. The thought problem itself causes the individual to function selectively. Certain characteristics of objects are given through perception, others through memory, some through imagination, and still others through recall. The relevant and necessary materials seemingly came to certain men more easily than to others. A great scientist once remarked that no man should be blamed "if understanding and knowledge did not come as readily as might be desired." When factual materials do come, they may not be significant to an individual because they are not understood. Men have at times possessed much of the fundamental basis for great discoveries, if we may judge in terms of the nature and amount of factual material which they possessed, yet have failed to achieve. Lyell, a most outstanding geologist, had gathered over a long period a vast amount of data concerning the various remains of extinct animal forms. Yet he had to open the page-proof of Darwin's *Origin of Species* to discover how near (or far) he had been to a most fundamental way of viewing life forms that made each significant for all others. By failing to integrate all, he missed originating the doctrine of evolution. That he understood this is evidenced by his

statement to Darwin: "I now realize that I have been looking down the wrong road."

Let us accordingly note that knowledge and thinking are not identical. There may be much of the former without the latter. One may possess many facts but do no significant amount of thinking. This does not imply, however, that one can reason without facts when such are regarded as being descriptive statements of meaningful characteristics of things. Generally speaking, then, there is little correlation between good memory, high intelligence, and high academic achievement on the one hand and thinking or reasoning out the solution to problems on the other hand. In a recent study, for instance, several individuals including university instructors were asked to solve various problems of the following type. White and black blocks were placed alternately upon a string with the exception of eight in the middle which were all white. The subjects were instructed to make a regular pattern of alternate black and white without breaking the string. Among various other objects on the table was a bottle of ink. Some individuals solved this problem directly; others failed completely. The successful said to change the middle white ones by blackening them.

Man often perceives and understands situations which he then proceeds to resolve through thinking. Occasionally, his car stalls. Here is a situation and an instruction: What caused it to stop and how can I get it going again? If it has stalled several times and he has observed its characteristics on these occasions, he may instantly recognize the nature of the trouble. There is no thinking in this case. If he does not know what is wrong, he may get out and look at the battery, the gasoline, the spark plugs, and the distributor. His "thinking" here may be as great as that of his companion sitting in the car who may proceed to suggest among many things that the trouble is due to a flat tire, an over-heated engine, or an inferior grade of oil. Moreover, if a dangling wire is perceived (and replaced) and the car then operates, no reasoning was done. Thinking is far more than perceiving. There is always more to the product of thinking than appears to the eye. The situation may be perceptual. But when the solution appears, it necessarily concerns a different phase of the situation — it has to do with non-perceptual relations. The story is told of a well-known scientist who was called to assist in increasing the efficiency

of a factory furnace, the fires of which were failing to burn in a satisfactory manner. He immediately observed that the furnace doors could be closed more easily than they could be opened. Other men had also perceived this difference but it had no significance; it raised no problem. The scientist then arranged for more air to enter the room; he then opened the furnace doors, and the fires burned properly. The furnace room was so built that the furnace had insufficient draft for desired efficiency.

Close perceiving (observation) as in this case may play an important rôle in thinking. But the two are not identical. We accordingly assume that thinking produces something not to be found through perceiving. Memory, too, may play a part; it may set a thought problem. Thinking may thus concern a situation which is remembered. An individual may "puzzle over" some thing which he observed years previously until he reaches a satisfactory solution. Memory also serves reasoning by directly contributing various materials. Man may possibly remember the incidents of previous occasions, and be helped in his present task. In closing this phase we point out an interesting fact. Often, students are able to solve a particular problem by an algebraic method. But they are unable, however, to solve it by using arithmetical methods, although they have had several years of arithmetical training in the elementary school. We cannot say, therefore, that they do not understand the problem; they actually work it. We can simply say that thinking is possible here, as elsewhere, only under certain conditions.

c. Variability in Approach. The appearance of a successful solution to a situation depends, at times, upon a certain degree of variability in the mode of attack. That is, when the desired outcome does not emerge under one set of conditions, a shift to a different set may possibly facilitate its appearance. We do not imply that any particular mode of attack (reasoning) must instantly produce success. Studies of thinking clearly show that a solution may suddenly come after a time even though the individual has not shifted to another attack. Of two persons who approach the same problem (black and white block problem) under the same set of instructions, one may immediately solve it, while the other may either fail or require much longer time. Generally speaking, the more efficient thinker may be regarded as *being persistent yet variable.* In the solution of mechanical puzzles, for example, one

individual spent ten hours on one unsuccessful line of attack. Even the definite suggestion that he change to a new line was resisted. Undue persistence, as in this case, may definitely interfere with the emergence of a successful or satisfactory product. Variable attack may well constitute one phase of ingenuity. The less efficient individual is apparently less able to *develop* new approaches. This persistence consists in part of an actual lack of ability to change, once a particular way has appeared and in part of an actual failure to realize that a change is now desirable. As evidence here we cite the results of an experiment in which the members of one group were not instructed specifically with respect to the desirability of changing after one approach had failed them. The members of another group were prepared, however, by being told to change, if they could, to a different approach as soon as it was evident that a particular way was not productive. The latter group was slightly more efficient when measured in terms of the total number of correct solutions developed. In this connection, we find full confirmation from one who has been outstandingly successful in solving practical problems. Kettering, for instance, states pointedly that often the best plan for him was one in which he tried the *opposite* of what was scientifically reasonable — in which he tried every way that was at all *pertinent* to the particular task.

d. Products of Reasoning. The products of reasoning as far as the functioning individual is concerned are partly new or novel. Similar products may possibly have been produced previously by other individuals. But as long as they are new to the particular producer, they may be said to be reasoned out. If man knows the solution and answer to a particular problem, he cannot reason about it. Modern arithmetic texts, for example, unlike older forms do not include a set of answers to the listed problems; for it is now realized that giving the student the answer to a problem normally causes him to avoid reasoning. In its place, he commonly substitutes understanding. He strives to relate the answer to some acceptable procedure; he tries to fit procedure and answer into a common pattern.

Man formulates theories, discovers facts, develops methods, and invents machines through reasoning. Darwin, for example, formulated the theory of evolution, Galileo discovered facts (properties) of falling bodies, Pasteur developed methods of combating

diseases, and Kettering invented the automotive self-starter. In these cases, as well as thousands of others, objects which were new when regarded in terms of some properties and relationships appeared. We assume, therefore, that man is able through reasoning to produce uniquely. That is, many things exist as a result of thinking which cannot be referred or reduced to a non-thoughtful basis. What emerges as a result of reasoning can have no exact equivalent precisely describable in terms of the individual's heredity or environment. Man actually faces new tasks, at times, and brings out new resultants. What he produces in this particular manner usually affects his subsequent functioning. Functional development of an individual is clearly marked by the emergence of novel products. The new in turn plays a determining rôle in his life. Life definitely proceeds in part by the addition of the new. That which issues from an *adult* could not possibly have issued from a *child*. One way in which man develops psychologically is through reasoning.

D. *Explanation*

a. Why Not More Reasoning? 1. *Lack of Problems.* We assume that, while man makes wide use of understanding, he is not commonly given to reasoning. There are many contributory factors here. One concerns the lack of thought tasks or problems. This lack is due at times to the absence of motives for thinking. Man oftens finds no occasion to reason. Life will unquestionably run its course without reasoning. The lack is also due at times to an actual inability to formulate adequate problems. One may face a difficulty, yet remain quite unable to establish a task which can be resolved through reasoning. Children and savages accordingly do little reasoning. Life is so simple with them that they have few or no problems which cannot be solved in other ways. A little child may possibly desire various objects. It may also be curious concerning many things. But it normally stops with understanding. Reasoning, however, commonly begins where understanding leaves off. The average child is either easily satisfied or it lacks the ability to formulate a problem.

An Illustration. The savage, for example, may actually entertain a strong desire for control. He may wish to secure food to prevent possible starvation; or he may seek a particular way of assuring success in battle. What *necessity* may do in the light

of ignorance is accordingly revealed in his case. The savage, as is similarly true of our more ignorant contemporaries, looks at the world around him. He perceives certain things in each particular situation. Lacking an adequate knowledge of causation, he deals with what he perceives to be present. Thus he establishes his causal relationship among objects. A particular object may be "discovered" to be the cause of his good fortune. It may be an object which he always carries or one which he finds in the successful situation. A major barrier to reasoning at the savage level exists simply because the savage does not recognize the matter of "chance." He holds that things which occur within a situation must be causally related. By perceiving the things present at some given movement, one form of causation and control may be discovered. But one does not perceive causation.

2. *Prejudice and Opinion.* Much reasoning is avoided by our contemporaries through resorting to prejudices, rules, and established opinions. When a thought problem has been clearly formulated, either by the individual himself or by another, no reasoning may possibly result because the whole process is aborted or short-circuited by introducing some cherished belief. Prejudice stands always as a major hindrance to thinking. The mere wish, for instance, to prove the truth of something may actually destroy the value of the thought product. Here lies a grave danger to the scientific value of the findings of an individual who "holds a brief." Prejudice is usually so subtle in its effects that many persons whose findings may appear to others as being biased may become indignant at the mere suggestion of possible prejudice. In addition to this factor, there is also the matter of indifference. Many individuals simply do not wish to bother. Where understanding ends, indifference often begins. It is more easy to accept than it is to question. Before reasoning can be done, such individuals must free themselves of their indifference. The college student may be suddenly shaken out of his complacency by a situation and at the same time so placed that reasoning may possibly follow. A major criticism leveled against the average student concerns his apparent apathy. He has failed to pass beyond the infantile or post-infantile period where he was necessarily forced to accept trustingly many thousands of things. When the time finally arrives for him to question, he often finds it either impossible or distasteful — he likes either to believe or to disbelieve. The

mark of the infant upon the normal adult is revealed by his blind acceptance or rejection where thinking is demanded.

3. *Persistence, Suspended Judgment, and Desire.* Other barriers appear. Reasoning is normally hard work. It always involves persistence in the face of difficulties. It necessitates both seeking and isolating various facts many of which may be quite uninteresting when regarded in a practical or in a socialized sense. Many persons are quite unwilling to spend the time and energy required in uncovering factual material. Moreover, they may be neither willing nor able to gather facts properly once they get to the sources. This usually implies the selection of a few and the rejection of the many. They may seek and they may select, yet they may signally fail to order their facts so as to constitute a meaningful pattern. The gathering of these data, which may take months or possibly years, definitely implies, of course, that the individual constantly suspends judgment. He cannot "make up his mind," yet at the same time proceed intelligently with his quest. Many students seem heartily to dislike being left hanging in suspense. They apparently want to settle each matter as it arises. When it has been settled or pigeon-holed, they are then ready to deal with the next thing. In this way, they are not unlike the intensely practical police-court magistrate who passes from one case to another, definitely settling each as he proceeds. Accompanying this necessary suspension of judgment in thinking, there also goes the definite intention or instruction to accept any material, regardless of its significance, which *bears* upon the problem. The quest rightfully concerns "negative" evidence as much as it does the positive sort. We accordingly point out that particular desires can find no place in reasoning. It is probably true that man can "prove" anything if he selects his data by taking that which pleases and by leaving that which displeases him. Because of this fact, we are always rather skeptical of the "conclusions" of a politician concerning his rival. We witness today the cool reception given the so-called "carefully thought out conclusions" of the extreme conservatives. Too often, it would seem, man is unable to reason because he cannot suspend judgment and control his desires.

4. *Lack of Factual Material.* Man often fails to think because he lacks the necessary factual tools. Regardless of his ability, no one can reason in the absence of facts. Information and

knowledge are required regardless of intention and of willingness to labor and of persistence. There is an admitted difference between the possession of facts and the ability to reason; they are not identical. Yet the one is seemingly dependent upon the other. There is complete justification for the psychologist's insistence that a grasp of factual material is vitally necessary for thinking. The significance of this is quite evident in all those cases in which men attempt to reason in fields where they are not adequately grounded in facts. The expert taken outside his own field may actually be trusted no farther than any other man. Let the student in economics, for example, attempt to think in the field of physics or chemistry and this truth immediately becomes evident. A primary requirement for reasoning in a particular situation accordingly concerns an individual's preparation by way of kind, amount, and understanding of facts.

An Illustration. As a striking illustration of the rôle which facts play in some forms of thinking, we cite the following account. It concerns the development of a method[1] of aiding in resuscitation. The experimenter here writes in part, "I questioned myself concerning what to do when the usual methods of resuscitation failed. I was following the theory of Haldane and Henderson. I knew, for instance, that carbon dixoide, inhaled by a person or an animal on the verge of death from too much alcohol or from drowning or surgical shock or asphyxia, was an acknowledged restorative. I knew, too, about manual manipulation to stimulate respiration. But what could be done in the case where the patient was no longer breathing and could not therefore take an inhalant — yet his heart was continuing its beating? I accordingly conceived the method of an intravenous stimulant.

"I knew that hydrochloric acid, when combined with carbonates, produces carbon dioxide gas, and that animals' blood in a state of asphyxiation was prone to shift to the alkaline side. I decided that a minute quantity of hydrochloric acid injected into the veins might produce the desired results. The simplicity of it seemed almost silly.

"I tried it first on a guinea pig to which I had given too much ether. The effect was instantaneous. That pig became conscious right away. I tried it on rabbits and rats. In all my tests since (300 of them) I have killed only three rabbits."

[1] By Pearl Moorman.

5. *Lack of Critical Approach and of Inherent Ability.* In addition to all these factors, there are two others which we must consider. Reasoning often fails to appear because man is not critical. He is unable to differentiate among relationships; to detect weaknesses; to pick flaws. Reasoning cannot proceed in the absence of exacting evaluation. There must be no willingness to bow to plausible self-evident relations. Neither the child nor the average adult is very critical. They cannot balance one thing against another. Moreover, they are too easily impressed at times by suggestions unsupported by facts. They also tend to give undue weight to particular items. In addition to all these factors, there remains an actual inherent inability to arrive through reasoning at some relationship. The common possession of normal intelligence does not necessarily equalize human beings in this respect. There seems to be no significant relation between achievement on intelligence tests and achievement in solving problems in the laboratory. Some individuals are more able to think than others are. The difference furthermore is not entirely one of training. Just as we can say that certain persons are much better than others in mathematics, so we can also say that some are better than others at reasoning. It is quite impossible, for example, to reduce the ability of clever chess players, so far as the ability involves reasoning, to intensive (wide) training upon such tasks. We accordingly assume that there are differences among human beings when considered in terms of their reasoning ability which can be adequately understood only by recognizing the significance of inherent determination. We assume then that man possesses functional properties which are in part inherent. Among these is thinking. It is accordingly impossible to provide individuals with the actual ability to grasp relationships.

b. Rôle of Images. Some students have sought to explain thinking by means of images which are put together through some mechanical "trial-and-error" process. Such images are usually regarded as being simple mental elements, which are unanalyzable and meaningless. In these respects, they are comparable to sensations. But the latter, unlike the former, depend directly upon functioning *sense organs.* These meaningless images come, in some not very understandable manner, to possess powers of mutual — or one way — attraction. One mental element may accordingly pull another with it into consciousness. By virtue

of this attraction, mental images are said to be associated together. No one, however, has ever successfully described or defined this peculiar attraction which one simple image is assumed to exert upon any other image. One, of course, does not observe it. To accept this position, one must believe in some form of mental force that actually inheres in — is basic to — each mental element. Upon occurring together (or in sequence) mental elements are assumed to become bound together more or less tightly by this mental force. Similarity also plays a part — two images which are somewhat alike may become closely linked to each other.

We must note, however, that images regarded as meaningless mental elements actually do no discoverable service in thinking. Careful experimentation has repeatedly failed to reveal the presence or the utilization of such mental resources.[1] Individuals accordingly solve difficult thought problems without observing the slightest trace of such mental elements. We must again point out that a *mental* image does not have size, shape, familiarity, etc. Anything which has *meaning* (size, shape) is not an element of the mind. An analysis of an *observed object* does not reveal mental things. Of the products of his thinking, man is quite sure. But of the nature of any purely mental aids he is not sure. During the solution of thought problems, he must unquestionably observe various *describable characteristics of meaningful objects*. Some of these may be described in this manner: This is the correct way; Try this object; Move it that direction; I cannot do it; I shall start it here; I shall break it; I shall put them together in this manner. Any one of these may come with or without an accompanying solution. An individual may actually say in one breath that he cannot solve a problem, yet in the very next breath state the solution. Man functions, we say, and a particular type of product appears.

Thinking is not a function of mind. It is a function of the brain. It is the manipulation of meaningful things in order to secure one particular type of meaningful product. To speak simply, after brain function comes meaning. Meaning really stands as one phase of brain function. There is no meaning until the brain functions. Nothing which is descriptively significant for thinking is to be found between *brain function and meaningful product*. In the same sense, we can certainly say that there is

[1] The student is referred to studies in imageless thought.

nothing between gland *function* on the one hand and gland *product* on the other hand. There is also nothing between neural functioning and reflex behavior (product). As a result of brain functioning, objects and situations possess observable characteristics. These characteristics are not present prior to the brain functions; yet the brain, of course, does not put them there in any sense of actually *injecting* them (in physical or chemical terms). Nor does the chemist claim that the burning property of an acid is present until one, for instance, places his finger or a particular chemically modifiable object into it. That is, speaking strictly, an acid does not burn the sides of the glass container or the air. Yet, chemically speaking, man does not inject acidity into such substances by putting his finger in them. We must realize that nothing can ever be known except in relation to other things. Psychological properties unquestionably characterize objects. Regarded as such, they are functional products of man. But they are of a different order from certain other functional products, such as bile or saliva.

c. Does "Trial-and-Error" Explain Reasoning? Meaningful properties characterize certain objects under particular conditions. Why they should appear at some particular moment as a direct resultant of a human brain functioning in an environment is really no more understandable than are literally many thousands of ordinary chemical properties of substances. Thinking should accordingly be regarded as being a unique functional property. By varying conditions both within and without the organism and by observing the nature of the resulting product, science may carefully study man's activities. This is essentially what science generally seeks to do. The student is referred for confirmation of this fact to the various methods of chemistry, physiology, and genetics. Here, for example, definite changes are made in a total causal situation and the product which issues is then carefully observed. The student will do well to regard psychology in a similar manner. Here, too, we find activities; and we have something produced. Because of the actual way in which observed objects or situations change as a result of thinking, we must question any explanation which is put solely in terms of trial-and-error. Such a theory is quite unable to explain the sudden emergence of significant relationships. It does not explain why a thing may come instantly to possess a *new* nature — to show a

new face. If it is used, however, simply to *describe* the fact of variability, or to refer to the fact that an individual may possibly regard a situation in various ways in order to reach a solution, there can be no objection. As a matter of fact, individuals frequently show considerable variability, yet fail to reach a solution to a thought problem. They may attack a problem without success in somewhat the same way that another does with success. The experimenter, who knows the solution, may often be sure that the unsuccessful individual is heading straight toward success. But he may never get there; for the really important step is often not taken. Just *why*, the individual may possibly never know. The student will do well to recognize here that much thinking may be done in the absence of any trial-and-error mode of attack. That is, an individual may proceed directly to the solution of the problematic situation instead of futilely rambling around it. We cannot ignore such cases. Neither trial-and-error nor some other form of "chance" procedure furnishes a wholly adequate explanation.

d. The Hunch. Perhaps the student will be aided here if he will regard the solution to a thought problem as being a kind of psychological orphan. Regarded in one way, it actually has no parentage. That is, the thinker may himself be wholly unable to define its sources. In this sense it is wholly comparable with the striking imaginational products which appear, as we have said, in the musically gifted composer. At times, the emergence may actually surprise the functioning individual; he may possibly do better than he expected. Moreover, the solution to a situation may appear when he least expects it. Regarded in this manner, it is quite similar to the ordinary "hunch." Let the individual who has had a hunch, attempt seriously to give it a dependable pedigree. He will quickly understand our point. The hunch usually has no observable psychological antecedent. It is a meaning — an intention or an instruction concerning something — that arises directly out of brain functioning. Its "mystery" lies simply in its lack of discoverable historical basis. It is a "bolt out of the blue." The superstitious and the ignorant commonly give it a mysterious origin. The critical individual, however, recognizes its actual breeding ground. He is accordingly less likely to play his hunches blindly. He normally returns to the same spawning place for further assistance.

e. The Rôle of Language. 1. *An Illustration.* Men have sought at times to reduce thinking to the level of *organic movement.* Regarded in this way, it is not so much a matter of brain functioning as of lip, tongue, throat, eye, finger, and chest functioning. It is assumed, for instance, since both speech and thinking gradually develop in the individual, that the two are necessarily related. Man talks (makes movements), therefore he thinks. No one doubts such simultaneous development; but one may very well question any direct causal relationship. Organic movement may pass possibly in theory, but it encounters rough treatment when it comes in contact with fact. For guidance, let us turn first to observation. Figure 91 may possibly be considered as representing a thought situation. Here is a heavy iron case (2000 lbs.) with a top of thin glass which is securely fastened into grooves in the iron. Through the glass may be seen four iron balls each weighing 25 pounds. Two are red and two are green. One red ball lies with the green. It got out of place during an earthquake. The student is expected to think out a way of getting the one red ball back with the other without touching the green balls. He may use any method of doing this which is *within the limits of the described situation* (paint, brush, small magnet, and twine). We now suggest that the student try very closely to observe to what extent he is directly aided by speech in reaching a solution to this particular situation.

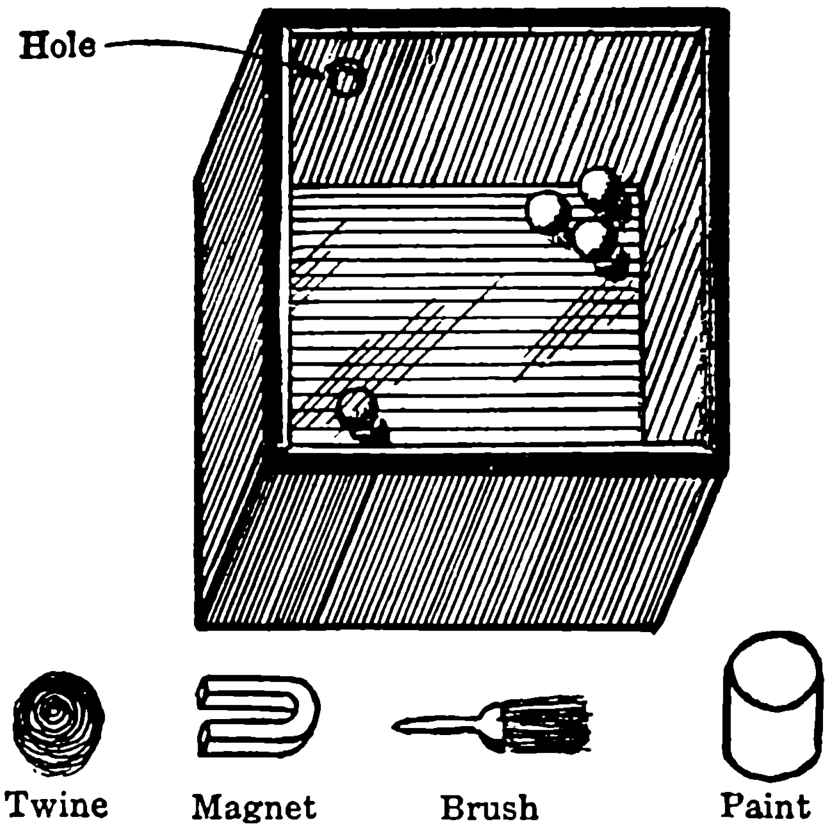

FIG. 91. Solve this problem and observe how much you are aided by speech.

2. *Evidence from Abnormal and Normal Individuals.* We are forced to reject speech as being an adequate type of explanation. Many facts stand against it. Individuals talk much, but think little. Moreover, man can continuously pronounce words or sing while thinking, as in the solving of puzzles and in playing chess. Fluent speech does not correlate with smooth thinking. Men may stammer or stutter, yet think clearly. In fact, speech may

be completely destroyed without impairing thinking. It has been repeatedly shown that superior intelligence (thinking) may actually occur in individuals who are affected with certain types of severe motor disorders.[1] This may be true even in those cases where the disturbances, due to birth injuries, have resulted in permanent impairment.

Experimental studies of normal individuals also reveal some striking forms of evidence. An apparatus may be directly attached to the tongue of the subjects in such a way as to produce graphic records of any movement.[2] An examination of the experimental data of such studies reveals no grounds for assuming that a significant relation exists between such organic movements and thinking. Some individuals, for instance, show many tongue movements; but the movements vary greatly from time to time when the same individual is asked to reason or to think of one particular object. Other individuals, however, show no recordable movements. Reed, for example, secured records of tongue movements, as well as of the chest and the abdomen, from individuals while engaged in reading silently and while silently counting and multiplying. Twenty-five per cent in the first case, 20 per cent in the second case, and 33 per cent in the third case showed some movements; but the remainder did not. Furthermore, the employment of delicate electrical devices to determine possible changes in the tongue muscles has clearly failed to establish any significant relation between thinking and tongue activity.

3. *Significance of Language.* Too much significance has been attached at times to language. That it has great social significance is not to be questioned; it furnishes a most efficient medium for socialized references. It definitely aids man in a large number of ways. Yet it has its distinct limitations. Speech should be considered as one kind of actional pattern directly comparable, in fact, to the movements of the fingers as in sign language or in typing a word. The words spoken in the one case or the patterns formed by the fingers in the other case commonly serve social ends. But when there is no need for such patterns, it indeed seems strange that man should continue to expect them to appear.

[1] The student is referred to studies reported by Lord, *Genetic Psychology Monographs, 7.*

[2] See studies of Thorson, A., "Relation of Tongue Movements to Internal Speech." *Jour. Exper. Psychol., 8;* and of Clark, R., "Experimental Study of Thinking." *Archiv. Psychol., 48.*

When they occasionally appear as in the studies referred to above, one can legitimately assume that they represent functional products due to irradiation from the central nervous system. They may appear at one moment in an individual but disappear during the next moment. Or, they may repeatedly appear without showing any uniformity from moment to moment. In this sense, they are to be properly identified with the random and non-significant movements which often appear in emotional situations. As a matter of fact, tongue movements clearly increase when there are interruptions (increased distraction), or when an individual is definitely striving to speed up a performance. Under these conditions, more energy flows to the effector system. Among other organic products, man may actually sweat and tremble. Normally, the brain functions in thinking as in perception, memory, and imagination without involving the effector system (muscles and glands). Man thinks with his brain and not with his muscles. Evolution has accordingly placed a major premium upon the development of brain — not upon brawn. Man is peculiarly characterized by his relatively large brain — not by his large muscles. Education seeks primarily to improve man's cortical functions — not his muscular activities. No one would seriously suggest that intensive muscular training would constitute a sensible approach to the problem of improving an individual's ability to reason critically. Nor would he suggest from an experimental position that language training, as measured by extent of vocabulary, might serve the same purpose.

f. Inherent Functional Property. An impartial examination of the facts leads directly to the assumption that thinking is in part an inherently determined functional property. It is a functional characteristic which has reached its most efficient form in man. It has developed along with those other functional and structural properties which tend in certain respects to make man a unique member of the zoölogical scale. Reasoning undoubtedly stands in part as functional expression of an enormously developed cortex. By virtue of the intimate relations which it sustains with energy sources in the outside world, various situations assume unique meaningful properties. That is to say, as a direct result of man's greatly developed brain, environmental objects possess characteristics which are very definitely lacking under other conditions. Relational properties accordingly appear.

They are, however, as definitely *caused* as any other property, either psychological or non-psychological. Upon this matter, one writer points out in part that the brain is a machine, but an organic one. It is a growing concern; it supplies its own fuel; it makes its own repairs. It is not, however, a machine that turns out a prescribed product, such as the ingenious contrivance that delivers cigarettes with the regularity of heart-beats. This has been invented by the thinking machine which was not invented, but has slowly evolved by natural stages in aeons of time. Of the way in which the machine is constructed and of its working, we know little. But the knowledge we do have helps decidedly to think correctly of the machine and its operation. *We judge the machine by its products.* These do not differ as do cigarettes, but in altogether different ways, for which the mechanical analogy fails completely. Thinking machines turn out a similar product but of widely varying quality. Each thinker must learn to know and to run his own machine. The original endowment sets limitations on the nature and quality of the product.

Unquestionably the most important single requirement for effective thinking is a brain well suited for the purpose. Everyone must face the task of making the best of his brains. Close thinking comes easily and naturally to some; they have a zest and a flair for the occupation, and they go fast and far. It is hard, slow plodding for others; their mental gait limps and lags, and their excursions are often short-ranged (Jastrow).

Man functions in a particular situation and a particular type of meaningful product emerges. The *product* is quite impossible without the functioning brain; and it is also impossible without the situation. That is, there must be a meaningful situation to be reasoned out. The change that comes under these complex conditions is a thought product. No one can possibly provide individuals with the necessary ability to produce such meanings (solutions). We imply as much when we speak of an inherent functional property. We can, however, definitely prepare individuals so that when they approach a particular situation demanding thinking, a satisfactory solution may result. We can do this among other ways by insisting upon their gathering facts, by suspending judgment, by being persistent, by varying their mode of attack, and by being critical. By refusing to be misled by easy opinions and fixed rules, the diligent individual may finally reach

that functional level where a "cool head rules and reason sits enthroned."

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OUTLINE

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CHAPTER XVI

EMOTION

A. *Introduction*

We have considered man in terms of various functional properties. Such functional properties are no more observable than are the functional properties of any chemical substance. Functional properties of one thing are always examined in terms of the changes which are produced in other things. We have found that man may perceive, remember, imagine, understand, and reason about objects and situations which he encounters in his daily life. Such things possess many unlike properties — spatial or non-spatial, relational or non-relational, temporal or non-temporal — as a result of his functioning. The objects of his environment are regarded in part as being definite and describable products of man considered in terms of life situations. These things possess unlike characteristics, each of which is meaningful. Man tastes, smells, hears, and sees objects in terms of their several properties. He perceives their distance, he recognizes their familiarity and he understands their relationships. But man also observes other meaningful characteristics of life situations. We have now to deal with those functional *products* which are directly concerned in emotion. Here we find some very striking evidence of the important part which meaningful *situations* play in human affairs.

B. *Nature and Significance of Emotion*

a. Nature of Emotion. Man is so constituted through heredity and personal history that he functions in definite ways under certain environmental conditions. As a direct result of this functioning, observed situations possess particular meanings. For example some are fearful, some are disgusting, and some are joyful. These affective meanings accordingly arise out of a complex set of conditions — a total situation — which involves an active organism on the one hand and a particular kind of environment on the other

hand. Where *either* is lacking, no functional products of the psychological sort exist. The little child, the animal organism, or adult man must necessarily *observe* some feature of a situation in each case of emotion. It is quite impossible, for instance, to divorce the perception of a fearful object from the emotion of fear. Man does not *just* fear — he fears particular *things* in particular *situations*. The visitor may not, for instance, fear the snarling tiger which he sees behind iron bars at the zoo; but he may very well fear the snarling tiger which bursts its cage and comes bounding toward him.

We must recognize, therefore, that particular situations carry particular emotional meanings and that as situations vary so do their emotional properties vary. They may appear, disappear, or shift. Nelson, for example, reports that while doubling in a Tarzan picture he had to walk unconcernedly across a clearing in which forty hungry lions were snarling and tearing at dummies stuffed with horse meat. To one side were armed men who were instructed to warn him instantly in the event that any cat left its feeding to stalk him. "Savage, blood-smeared heads lifted momentarily and wicked eyes glared," he writes, as the creatures watched him pass. Suddenly the situation changed; there were warning cries from all sides. He whirled, reaching for the blank pistol in a holster hidden in his loin-cloth. It stuck. Two cats, not five feet away from him, crouched tense in the attitude well known to animal men. There was only one thing to do, and he did it. With a yell, he leaped at the furious pair, brandishing an imaginary stick. They backed down and, Tarzan-fashion, he climbed his tree.

In our emotions, there is always *something* which, for example, pleases or displeases or which frightens or angers us. We may glow with pride in one situation and blush with shame in another situation. The *perception* of something is an inseparable feature of many (not all) emotions. The nature of the thing thus perceived may, of course, vary greatly from individual to individual. What constitutes a disgusting situation to one may not be so perceived at all by another individual. Uncleanliness, for instance, may or may not be disgusting. Words spoken by one individual may be amusing, but spoken by another may be very displeasing. We recall in this connection the sharp warning in *The Virginian:* "When you call me that, smile!" Functionally speaking, a particular *meaning* emerges suddenly in a situation and this

definitely constitutes in part the emotion. "The names," Bentley remarks, "which we commonly bestow upon the emotions are meaning names. Thus 'fear' indicates that 'here is an object or a state of affairs which threatens'; anger that 'this act or attitude must be protested'; joy that 'this turn of events brings what I want'; jealousy that 'this person receives that which I desire.'"

An individual may respond to an emotional situation in many ways. In every case, we must not regard man as responding to a stimulus when considered as forms of physical and chemical energy. He responds instead to meaningful characteristics. In fear, for example, he may run, crawl, roll, or remain quiet. He may scream, whisper, or whistle. He may "step lightly, bow low, and laugh loud." He may, in short, carry out any one or more of a large number of possible action patterns. What he actually does depends always upon the nature of the observed situation as well as his personal history and the particular premium laid upon adherence to certain rules of conduct. One may readily run in one situation; but stand and die in another. The soldier may be dreadfully afraid, but he commonly does not run unless the particular situation permits such actions. To make our point clearer, we suggest that fear may instantly emerge (arise) in a threatening situation where an individual is quite unable to do anything to resolve it. As soon as he is able to deal quite *adequately* with it, however, the whole situation may instantly change. When a situation thwarts more than it threatens an individual, anger may instantly emerge. As soon as he can meet the situation — remove the barrier — the anger may disappear; the situation is then observed to be different. Its meaning has changed. The emotional situation, as is similarly true in the choice situation, seems always to involve the observer in a *personal* way; it touches intimately upon his standards, values, possessions, desires, or wants. A soldier is not sorry for his enemy; a Simon Legree is not indignant about the abuse of slaves; a little child or adult idiot may laugh at one who is burning to death; and a member of a mob may shout gleefully at the convulsions of his strangling victim, or push angrily at a fellow member who obstructs his view.

b. Differentiation. The student will perhaps secure a better grasp of the nature of emotion if he will try to differentiate among them. How may one emotion be distinguished from another? How, for example, does love differ from hate, or joy from sorrow?

As we shall later show, adequate distinctions cannot possibly be drawn in terms of physiological functions and their products, *namely*, circulatory, respiratory, and glandular phenomena. The former conception of specific bodily patterns which stand for specific emotions, as held by James and others, is certainly insufficient; it has failed to withstand rigorous experimental testing. The distinctions must accordingly be drawn in terms of *meaningful* characteristics of total situations. An individual may observe and describe a situation in terms of its emotional properties. He must be depended upon in this case just as he is when he reports upon the color, sweetness, shape, distance, or familiarity of an observed object. He may report that one object is red and that another object is green. In a similar way, he may report that one situation is fearful and that another is disgusting.

Illuminating results were obtained by Sherman in his experimental studies of emotional differentiation among babies by adult observers upon the basis of observed behavior patterns. They clearly show the importance of the situation. Hospital nurses, medical students, psychology instructors and students were asked to observe babies and motion pictures of babies. Under one set of experimental conditions, pictures of the babies together with the stimulating situation were shown; under another set, pictures of the babies (but not of the situations) were shown; and under a third set, the babies themselves were shown without the stimulating situation. The stimulating situations involved hunger, sudden dropping, sticking with needles, and holding the head and arms of the babies. When the several observers had *no* knowledge of the particular situation, their accuracy in stating the particular emotion — fear, rage, etc., — was about equal to that of chance. Their reports were wrong about as often as they were correct. Of 119 judgments of emotion, for example, 49 were of anger. Of these 49 cases, 11 were so named although the situation was one of *hunger;* 14 really followed sudden *dropping;* 13 came after tight *restraint;* and 8 of the 49 judgments of anger actually followed applications of a *needle.* The nurses, for instance, were unable beyond chance to distinguish between the hunger cry and the anger cry. Psychology students were actually no more successful in identifying the several emotions than were Normal-School freshmen. The majority of the several students "who were successful in making the differentiation stated that the knowledge of the

stimulus influenced them in their decisions or that they knew that no other emotional response would result from a certain stimulus."

Differentiation of emotions must start with the observed properties of the situation. The emotional characteristics belong to the whole situation — they are not *within* the individual. The individual functions in a particular way. As a result, a given situation comes actually to possess unique properties. Some of these meaningful properties belong at times to the order of emotions. Cannon, for instance, has clearly shown the presence of a like (undifferentiated) physiological (bodily) pattern accompanying unlike emotions. One emotion cannot, therefore, be clearly distinguished from another in terms of strictly physiological products. Rage, for instance, does not reveal itself to the experimenter through one particular bodily pattern and fear through a different one. In this connection, Carr remarks that the "various emotions can be readily identified and defined only in terms of the behavior situations in which they occur rather than in the basis of their organic composition." [1] We accordingly suggest that the *same* bodily pattern may accompany a variety of unlike emotions. Functional distinctions must therefore be drawn in terms of meaningful situations. Thus anger may emerge at one moment and pity, perhaps, at the next moment.

c. **Shifts in Emotion.** These sudden shifts really shed considerable light upon the nature of man's emotions. They reveal how easily the organism may change functionally following a change in the observed situation. Emotional shifts may move rapidly from anger through sorrow into fear. While angry, one may possibly strike a loved one so violently as to cause serious injury. The instant recognition of this may bring great grief which may in turn be replaced by terror. The play, *John the Baptist*, portrayed the rapid shift from jealousy to anger and on to profound grief. One may, for instance, observe unusual joy in participating at the moment in a satisfying situation. But the joy may turn suddenly into strong fear, and one may then seek to escape from a previously satisfying *object* (human being). That which was joyful becomes fearful. A joyous group may instantly be turned into a terrified mob by the shout of fire or earthquake. Every individual must have observed this flow of emotional changes especially in memory

[1] Carr, H., *Psychology*. For an excellent discussion, see "Differentia of an Emotion" by Carr in *The Wittenberg Symposium* (1928).

and imagination. A series of meaningful situations may flow along in which there may be anger at strong opposition, hate of an arrogant antagonist, and fear of the possible consequences of open defiance. Unable to escape from bitter humiliation, an individual may possibly run again and again through this cycle of emotional situations. The most illuminating feature, psychologically speaking, of this sort of emotional functioning concerns the possible absence of all significant bodily activity. The observing individual may lie quietly, or with hands in pockets he may move around his room. The perceptual situation may be wholly absent. He may be observing simply in memory or in imagination.

d. Significance of Emotional Products. Man's emotions unquestionably play a very important rôle at times in his life affairs. They are intimately related to his various wants, needs, values, and standards. They serve, in general, as significant forms of functional guidance; they sustain and instruct the individual. They commonly lay a definite demand upon man; he must do something or try to do something. The emotional situation, we said, is always personal. It may satisfy by giving or it may displease by taking away. Man may strive to obtain what it offers; and he may attempt to hold what a changed situation would deny him. Thus fear, anger, and love unquestionably serve as powerful motives which tend often to drive man to further achievements. They are meaningful characteristics which dominate his behavior. Under the spur of an emotional situation, man often acts in ways which would not otherwise appear. Patterns which have wide social consequences accordingly emerge. In school, in business, in government, and in the professions, we often find that patterns of dishonesty and disloyalty appear under the fear of failure or through anger at some associate.

Emotional situations serve at times to bring wide-spread and profound changes in individuals with respect to life affairs. The religious convert furnishes a striking example of this nature. Revival meetings are often marked by the conversion of persons who have led most unsavory lives. There are some evangelists who are widely known for their ability to create emotional situations of such a nature as to cause individuals to "join the church." That large numbers actually respond at times in this way is granted. But the *permanency* of such changes is another matter. As long as the original emotional situation persists, the converted individual

is generally able to sustain his action patterns in the light of his new goal; he is able to order his life affairs at a different level. Unfortunately, however, in many cases these emotional characteristics apparently do not endure. Many individuals accordingly "backslide" they gradually or abruptly return to their formerly satisfying sources as the emotional meanings which lead to their conversion drop away. The student's understanding may be helped here by considering the significant fact that certain outstanding evangelists do *not* follow the usual custom of having an individual become a signed member of an organization. Lacking the emotional support that commonly issues from a formalized institution, many converts seemingly return to their earlier status. Their conversion, measured in terms of permanency, was quite ineffectual. Such loss, however, must not be permitted to obscure the fundamental possibility of producing great changes through emotion.

Emotion, however, is not always a hard master which pushes man on to other things. Many of his joyous moments are actually ends in themselves. Such situations drive man toward no remote end unless it is merely to continue themselves. In this connection, we discover some interesting facts. Individuals may, at times, enjoy emotional situations which are really very sad. It is not uncommon to find people weeping in the theater or suffering vicariously with the heroine of a novel. Such emotional circumstances may also be indirectly distressing. Some persons find that emotional scenes of the theater or the novel are really too much for them. They are unable to stand the strain of living through these emotional situations. Emotional situations may accordingly serve to motivate human beings — to push them forward by holding them to a goal; or they may serve no end other than the satisfaction, gratification, and happiness which a particular situation momentarily holds out to them. Whether there is or is not an end in emotional functioning necessarily depends in part upon the nature of the situation.

Emotional situations are commonly socialized; that is, they generally involve both the functioning individual and another individual of a like kind. Man may be emotional in situations devoid of other human beings — as in fear of an avalanche or of a charging elephant. But the majority of his emotional meanings are undoubtedly concerned with other human beings. Shame,

modesty, jealousy, sorrow, joy, pride, loyalty, and the like clearly illustrate this fact. Emotions accordingly have wide social significance. We act socially with respect to an angry man in one way and to a terrified man in another way. Anger or fear, moreover, may spread rapidly through a whole group. Recently in New York, a serious street fight involving several hundred negroes and whites resulted from an alleged beating of a small negro boy accused of stealing a ten-cent article. Many of the persons who participated in the fighting actually admitted that they did not know what originally started the fight. Race differences contribute too readily to emotional functioning. Sorrow, moreover, is customarily *shared* by relatives and friends. Untold thousands, too, have been slain in religious wars. And man continues to fight and, if necessary, to kill in order to sustain his love situations.

Biologists have long attributed great significance to the emotional functioning in terms of its survival value. They regard emotion as a racial agency which contributes to favorable adjustment. Fear tends to remove an organism from a dangerous situation; love, of course, contributes to stock perpetuation; and anger serves to assist the individual in removing its enemy. Such biological writers frequently seek to relate emotion to some instinctive pattern. Fear is assumed to arise in connection with the instinct of flight; love with the sex instinct; and anger with the instinct of pugnacity. Such students tend, moreover, to consider the organic changes as constituting fairly definite patterns which necessarily characterize each particular emotion. Such patterns have survived because they have been useful to the species in the struggle for existence. The human sneer, in which the lips may be pulled back to expose the teeth, is accordingly regarded as coming directly from primitive combat at a subhuman level where the teeth were used as weapons of attack. We readily grant that the puppy or the kitten will expose its teeth in situations which we might interpret as being either fear or rage. But it will similarly expose its teeth when *playfully* mouthing the finger of its master. We certainly do not wish to suggest that there is not an inherent basis, especially at the subhuman level, for many emotional patterns of organisms. We do not assume that the angry bull gradually learns to show rage or that the young kitten slowly learns to arch its back and spit in some situations and purr in other situations. But it is a far call from the exposure of

teeth in an angry animal to the so-called sneer in an envious human being. Man undoubtedly has had a very long history, but our understanding of his emotional behavior is not materially advanced by dubious analogies. Man must create emotional situations before he can respond psychologically. His emotional functioning unquestionably has an inherent basis. But each particular emotional situation must be observed in terms of its meaning — of the relationship which it bears to man. As we have said, no organism appears to fear any particular situation when considered independently of what it *does* to the organism. When any observed object *harms* an organism, fear then tends to emerge.

Cannon, for example, has suggested that emotions, *biologically regarded*, commonly possess an emergency value. They are useful in so far as they assist the organism in dealing more effectively with critical situations. As we shall later show, the individual may be physiologically prepared for the momentary expenditure of unusual amounts of ordinary energy. In short, the organism may be placed upon a war-footing. The individual is accordingly able, in a purely *biological* sense and to a limited degree, to maintain itself more adequately. Emotional functions may thus have survival value. That they may actually serve such biological ends should be evident. If fear results in removing an organism from a destructive situation, it unquestionably contributes to its survival. But fear may very well carry the same organism to its destruction. The fear of possible dishonor has repeatedly caused some men to face torture and other men certain death on the dueling field. We can only dimly understand the emotional fervor that sustained the early Christian martyrs under the agony of the rack and the lash. Yet we so often hear persons complacently remark that "only the weak allow emotions to govern them." Only those who know much of morals and little of life are ready to say what man will actually do when he faces crucial situations.

It is seemingly as impossible to find any biological value, for instance, in the excessive trembling of the limbs and in the noisy chattering of the teeth in case of fear as it is in other cases where the eyes may roll completely back in their sockets and where various *excretory* functions may become involved. It is, moreover, very difficult to find any survival or *emergency* value in such ordinary emotions as joy and grief. As Carr has clearly pointed out, "such a conception encounters difficulties" in its treatment of

some emotions. "Joy differs from fear and anger in that it has no adaptive significance." In general, the student will be well guided in his understanding if he does not place too much significance upon the strictly *biological* features of emotional functions. We clearly recognize, of course, that the organism is a functional unit and that when nervous energy is dissipated widely over the organism the whole effector system — muscular and glandular — may be indirectly involved. But it remains to be shown that such muscular and glandular products necessarily contribute in any manner to organic survival. It is well-known, for instance, that the alimentative and the excretory systems may become widely involved in cases of intense emotions (e.g., fear) but the particular survival significance of such functioning has yet to be indicated.

C. *Emotions and Other Psychological Functions*

a. Perception. We unhesitatingly assume that emotions occur (and can be known) only in connection with some object or situation which the organism observes. This definitely implies that a particular thing is, among other ways, perceived, remembered, imagined, or understood. There can be no emotional situation in the absence of such functional modes. Genetically speaking, perception is undoubtedly the earliest of these ways. It is probably the only way at certain subhuman levels. We hold that animals during the course of their development come, as a result of what is done to them, to perceive something to be avoided or, if this is impossible, to be attacked. They neither reason nor understand. They retreat from or they advance upon an object which they observe before them. It is that kind of object. To perceive in such cases is to be emotional.

b. Memory. Human beings, however, directly observe in *memory* many unlike situations each of which may bear particular emotional characteristics. Every normal human being clearly realizes the frequency and the significance of such emotional meanings. Man may produce, time after time, a humiliating or satisfying situation and suffer in the one case or delight in the other. The poet has expressed this memorial satisfaction quite well in these words:

> "I would willing die without a single regret,
> If I could call back that day, whose sun is set —
> And you, and live it over."

Some students suggest that man cannot remember his emotions, that is, his previous emotions cannot be revived. We would agree. As we have said, man does not really recall anything, in the sense that a previous thing is brought out of storage and reëxperienced. He again functions, however, in such a way as to produce particular situations which he identifies with those of his own past. These situations may or may not be emotional. Many memorial situations have no more emotion than many perceptual situations. Man literally perceives thousands of things each day without any attendant emotional characteristics. But he may also perceive many which are emotional. Memory of a particular thing may take different forms. It may well be that, at the moment when a particular situation which was previously satisfying is produced in memory, the organism actually has no need or want to be satisfied. Under such conditions, an object may be recalled without any emotional characteristics. The same thing, however, upon being remembered at a later time may possess strong emotional properties. In memory, situations may be suffused with emotional meanings — thus we often speak of memories which bless and burn. The memorial references to a loved one who is absent bear full evidence upon the nature and extent of such emotional meanings. At times, we may recall loved ones without emotion; but at other times we may suffer keen anguish and longing. One, then, does not revive or recall the same emotion which he previously produced. But he does function frequently in a remembered situation to produce certain emotional products.

c. **Imagination.** Imagination also offers striking evidence upon the nature of man's emotions. A vivid imagination may constitute a fertile source of many emotional situations. That is, man often produces objects in imagination which greatly terrify, anger, or satisfy him. Worry and anxiety, for example, may accompany situations which threaten both his present possessions and his future existence. An individual does not worry about nothing; there is always some object, situation, or set of circumstances about which he is emotionally concerned. Whenever an individual in imagination observes that a thing which he values is affected, either favorably or unfavorably, emotional meanings may promptly emerge. He may be joyous, sorrowful, jealous, envious, fearful, or angry. Much of man's planning, as far as the satisfaction of his more important needs is concerned, is emotionally characterized.

His day-dreams, as we have said, are seldom lacking in emotional meanings. In them he usually discovers a source of satisfaction — he overcomes obstacles, achieves greatly and receives recognition. To disregard the emotional meanings or characteristics in such cases is to ignore a very fundamental truth. To regard such functioning and such products as not being *real* is actually to reject fact for the sake of theory. The emotional ardor that may emerge under the whip of a keen imagination often equals or exceeds that of perceptual situations. It is partly true that anticipation may be more satisfying than realization.

d. Thinking. Emotional meanings also arise with thinking. This is strikingly true of understanding. In certain situations, emotion seemingly stands as a partial measure or an indicator of an individual's understanding. In describing a dangerous situation, we may possibly insist that our undisturbed friend "does not really understand" what we are saying. He cannot understand, we insist, because he is not emotional. The apparent absence of a significant degree of understanding in animals clearly removes them from the many emotional vicissitudes common at the human level. Animals accordingly face neither the dread of insanity and senile dependence, nor the exultation of vindication and high achievement. In thoughtful situations, however, emotional functioning commands no premium. Reasoning, we say, demands a cool head — an individual may possibly grow very angry or disgusted with some situation which baffles him. It is also true that the emergence of a solution may have wide emotional consequences. Upon producing some solution, an individual may be horrified at its possible significance to himself or to society. The discovery of certain deadly agencies of warfare has frightened men and caused them to express deep concern over their possible consequences.

e. Action. In action, we come again upon a functional characteristic of man which may be greatly affected in emotional situations. In such situations, man tends at times "to go to pieces." If a perceived situation makes unusual demands of an individual he may end by doing nothing that advances him toward an adequate achievement. Because he often attempts to do too many things in a short time, he often does no one thing properly. Men differ decidedly in their respective abilities to maintain themselves in critical situations. Some seemingly succumb very easily. Others stand up under terrific pressure. We must point out, however,

that a valid measure of emotion cannot be found in terms of degree of such resistance. That action patterns may be disrupted in emotional situations must be granted. But the disturbance may be due to the nature of the particular action pattern itself as well as to the nature of the emotional meanings. If he is not adequately *prepared* to meet some emotional situation, man may respond to it by cursing, striking, or sulking. An individual may be unable to say the proper things or to move effectively because he does not actually know what to say or he does not know what to do. The untrained driver may be quite helpless when his car begins to skid on a slippery highway. A person gets into a traffic jam. He may sit and ask helplessly "*What shall I do?*" If he is then instructed by another to observe his own car — not others — and to act in a certain way, he may proceed without further trouble. If he is not instructed or cannot observe in this manner, he may be quite helpless. Excellent insurance against such emotional disturbances of action patterns unquestionably comes through full self-assurance and from not placing too much weight upon what the other fellow may happen to think or say in a social situation. If we do not value something very highly, it cannot carry much emotional meaning. To place little weight upon certain situational aspects is to be nonchalant. Emotional effects upon action patterns are directly attributed, therefore, to the failure to observe *steadily* particular features of a situation. By hurriedly jumping from one thing to another, an individual's resulting actions tend to become erratic and chaotic.

D. *Development of Emotion*

We regard emotion as being a functional characteristic of man which is to be defined and described in terms of meaningful properties of observed situations. We assume that this function starts quite simply, as measured in terms of the situational conditions, and develops gradually as an individual grows psychologically. Organisms are so constituted, for example, that anger or fear may *suddenly appear* without previous personal preparation. Sherrington, for instance, carefully guarded young dogs against all emotional situations until they were about two months old. At this time, under adequate conditions, emotional behavior suddenly emerged. The child, moreover, which has never previously faced an emotional situation, may also suddenly exhibit

action patterns which are commonly interpreted as being anger. Holding or restraining a child, especially when it wishes to do something, may be one condition of anger. As a result of the nature of its understanding and observation as well as its simplicity of needs, there are actually very few situations which can thwart or block the young child. It has, among others, no professional, economic, social, sexual, educational, and religious standards and values which may be affected adversely. We must not, however, confuse causation. At one level of development, there may be one set of causes. At another level, there may be many new causal factors. The new, moreover, must not necessarily be considered as developing directly out of the old. As life situations gradually increase in meaning, the possibility of emotional functioning undoubtedly enlarges. As life affairs become more diversified, emotional meanings inevitably become different. We understand, then, that the anger which may readily appear under some unfavorable reflection upon one's religion, achievements, parentage, college, and country; under a snub or a sneer; under a direct threat to some valued object or loved one; or under the removal of a satisfying environmental object need not be assumed, at all, to arise out of earlier (original) conditions of anger, *namely*, physical restraint.

Man grows functionally. New situations possess properties formerly characteristic of old situations. Or, old situations take on entirely new properties. No one doubts that emotional extension occurs. But it seemingly depends, however, upon the gradual extension of other — non-emotional — functional properties. The development of language and understanding plays a significant rôle in man's emotional development. As a result of the former, the actual number of possible emotional situations increases enormously. Through instruction by language, the child comes to love God and to fear the corner policeman. His companions, through verbal descriptions, may directly prepare an individual so that he functions emotionally; he is lead to produce particular meaningful situations. If one is told, for instance, what is going to happen to him when he finally faces an individual in an authoritative institutional position, he may be needlessly frightened or angered. The rapid diversification of emotional situations during the early years is partly attributable to the influence of language.

Fools, we say, lacking understanding, rush in where angels fear

to tread. This holds as well for little children. The small child may toddle unconcernedly into the path of a heavy truck; or, attracted by its buzzing, the child may crawl interestedly to the deadly snake; and it may take liberties with fire and other biologically harmful sources to a degree equalled only by the feeble-minded or the "insane," in whom proper understanding may be partially absent. Formal as well as informal child training necessarily consists largely in so ordering conditions that certain desired emotional meanings will emerge in life situations. Proper rearing definitely involves functional preparation through an appeal to the child's emotions by way of its understanding. The individual is accordingly taught to love some things and to fear other things. As understanding develops, emotional situations elaborate. But with such development necessarily goes the possibility of misunderstanding. Many emotional situations unquestionably arise solely as a result of the nature of the thing understood. An individual may understand too little or too much. In general, intelligent preparation commonly appeals less to prejudice and suggestion and more to an understanding of the significance of things in life affairs. Intelligent preparation must approach man's emotions indirectly by way of his other functions. Emotional development is inseparably linked with non-emotional development. The young child, for instance, is not jealous or coquettish; proper situations must be created before such emotions appear. This holds similarly for other emotions. Creation definitely implies the emergence of something new.

E. *Do We Learn to Be Emotional?*

a. Watson's Three Inherent Emotions. Some students seemingly make short shift of this important problem. They assume that, aside from a few situations in which emotion issues from an *inherent* basis, all emotional responses are acquired; man learns to be emotional. Watson's uncritical theories have been largely responsible for this particular conception of the basic nature of man's emotional life. From his studies of infants under certain situations, he advanced the theory that only three emotions, *namely*, love, rage, and fear are unlearned; they are forms of hereditary equipment. They represent racial contributions to modern man. Stroking and fondling, for instance, give the first; holding the arms and head cause the second; and dropping or a

loud sound is a necessary condition for the third. Watson accordingly described three specific bodily patterns for these unlike emotional situations. He went further. From dropping or a loud sound, he said, come all later forms of fear. The emotions of a *normal* adult who may possibly fear some one particular situation, or of a *psychotic* (diseased) adult who may possibly be afraid in many life situations are reducible, according to this conception, to simple situations actually effective during the first hour of life. Each case goes back to a matter of dropping or of hearing a loud sound.

b. The Inadequacy of This Approach. Such an interpretation, however, is adequate neither at the human nor at the subhuman level. Animals, for example, are not afraid of situations in which loud sounds are observed, provided other factors such as injury, noises made in pain, and sight and smell of blood are not present. It is scarcely adequate to hold that an organism would fear an object which it merely heard but never felt, and fail to fear an object (electric grill or red-hot poker) which it did not hear but felt. Every hunter, moreover, knows that it is possible to shoot several squirrels from out the same tree as long as he remains quiet or hidden.

Furthermore, many hungry animals while feeding will angrily attack any other animal that approaches them. Nelson, for example, remarks that so-called tame lions are extremely dangerous when they are feeding. Moreover, highly domesticated pets will often attack their owners when the latter attempt to remove their young. Even non-predatory birds will attack man under these particular conditions. The student will note in these, as well as in many other cases, that holding or physical restraint cannot be cited as the causal factor in emotion.

c. There May or May Not Be Emotional Learning. We assume that regarded in one sense, no human organism learns to be emotional. Learning commonly involves the concept of practice, understanding, repetition, trial-and-error behavior, and intent to acquire. There is commonly a goal or end to be achieved; there is usually a thing to be *mastered.* Considered in these ways, there is probably no emotional learning. But when learning is considered to describe or refer to the appearance of something new, then there is emotional learning. Learning, itself, is not wholly independent and separable from man's various psychological functions. At a

later time, man may function differently from the way in which he earlier did. The later is dependent, therefore, upon the earlier; that is to say, the earlier introduces definite causal factors. As a result of learning, man is commonly regarded as being more *efficient* upon later occasions. To the extent that it can be sensibly shown that man's emotions are actually more efficient as a result of his previous activities, he may be said to have learned. Emotional learning is more closely tied up with the matter of control. We commonly seek to *control* the causes of emotions.

We accordingly assume that emotional products always appear under definite conditions. When the several contributory factors for them exist, such products must necessarily emerge. Such functional results are as much caused as any other kind of product, either psychological or non-psychological. There must be an organism and there must also be a situation in which it performs. Functioning without a situation is, of course, utterly impossible. What constitutes an emotional situation for one organism does not necessarily hold for another. In these cases, the differences in causation may be referred to heredity, to personal history, or to the particular environmental conditions. But large functional uniformities apparently range throughout particular life forms. We know that with few exceptions, to molest a bear cub in the presence of its mother is to invite trouble. Similarly, to injure maliciously a man's child is to solicit a fight. In such cases we do not assume, of course, that learning by any form of trial-and-error method, for example, is either required or actually occurs. The functional ability is unquestionably present; but a situation is always required. When the latter appears, emotional functioning occurs. A mother bear lacking cause may possibly never fight because of her cub; there must always be a molesting object to fight. In the adult human, anger usually appears when he is thwarted in his quest for satisfaction or when that which he possesses and values or wishes to possess is threatened, questioned, or harmed. When man's desires, beliefs, abilities, structures, standards, goals, institutions, habits, home, and honor are involved in a particular manner, anger is most likely to emerge. Helen Keller, for instance, has described in an illuminating manner how angry she became when, as a partial result of her blindness, deafness, and mutism, she was unable at times to obtain particular things which she desired. She would finally fly into fairly uncon-

trollable fits of rage. Deaf children, we know, will cry as lustily under certain conditions as do normal children. In short, emotional functioning in the blind and the deaf is in certain respects strikingly like that of the perfectly normal individual. Such facts must be properly evaluated in considering the basic nature of man's emotions with respect to the causal conditions.

In the development of his various desires, we accordingly discover an illuminating clue to man's emotional development. As he grows older and as his desires inevitably increase in number and become more diversified, we discover a more varied basis for emotional functioning. The normal adult has many desires utterly unknown to the young child, each of which is potentially capable of indirectly causing such various emotions as love, hate, fear, jealousy, envy, sorrow, and anger. Not only does he have new desires, but they are far more intense. We do not find drug addicts and alcohol "maniacs" at the child level. We do not find children killing in order to secure dope. The adult deliberately seeks *situations* for which the child lacks both a bodily basis and an understanding. At the level of desire, the world of the child is very simple in comparison with that of the adult. The complexity of the adult world is not derivable, moreover, by way of mere combinations of the several simple features of the child's world. Psychological development brings variety; new characteristics emerge — among these are the emotional products. Civilized living at the adult level cannot be adequately described as a summation of particular elements found at a more primitive level. The highest level of living is remotely removed from lowest (largely vegetative) level. In this sense Tennyson was not wholly wrong in ranking the gray barbarian lower than the Christian child. We wish to suggest that in the increased number of possible emotional situations may lie the key to the greater incidence of psychological disorders among civilized peoples.

d. The Rôle of Personal Past. The personal history of each individual necessarily plays a very important part in determining the nature of his emotional functioning at any given moment. It unquestionably stands as a major causal factor. We may look for confirmation here either at animal or at man. In both cases, we may possibly regard the organism, as we may a piece of steel, *namely*, as having a breaking point. An organism — a dog, for instance — may be teased (interfered with) until it suddenly

becomes enraged. No one can actually predict the first time what will happen.[1] Everyone recognizes that many organisms may be handled for a time without the least sign of emotion being revealed. Then quite suddenly, emotional products appear. We would hesitate to suggest, however, that the organism has in this case learned to be emotional. Nor would we do so, even if the organism upon facing the situation an hour or a day later should continue to show emotion. To cite an analogy, we would not say that a piece of steel, as in an airplane, suddenly learns to bend or break. Changes must occur, we assume, during the history of a functioning thing and such changes may actually serve as causal factors of some other change. Because of man's personal past, situations come to possess particular emotional characteristics. Or, situations which never before possessed such particular meanings may suddenly show them. The lives of abnormal individuals clearly reveal the truth of this statement; they may come *suddenly* to hate or fear objects as they never did before. That the emergence of these properties in certain forms of emotions depends in part upon personal history is shown, we suggest, in the unlike functioning of two individuals who face a social situation. The one may report anger but the other may report fear. In so far as an emotional set may operate in a particular individual, we have his past definitely influencing him. Human beings tend, we know, gradually to change emotionally as a result of increased age. Youth and old age show radical differences. These slow developmental changes shed very significant light upon the functional properties of man.

F. *Emotional Functioning in Old Age*

The old do not have as many desires as do younger individuals. Moreover, they are commonly more removed from many life affairs. This is especially true of those dependent ones found either inside or outside institutions. Too often for proper emotional balance, such individuals develop an attitude of inferiority; they are no longer consulted; they no longer exercise a voice in life affairs. They may once have been somebody; but they are now nobody. They may accordingly have fewer objects upon which

[1] During May, 1935, two well-known animal trainers were killed — the one by a tiger and the other by an elephant. In each case, the animal had a good record. The elephant, for instance, had never given the least trouble in twenty-five years. Each turned suddenly against its trainer and killed him.

they seriously place *values*. It is not unusual, therefore, to find them both apathetic and indifferent where earlier they were responsive and enthusiastic. Their pleasures are fewer and relatively simpler. But when those remaining things which are valuable become involved, we may find a surprisingly strong display of emotion. This may account in part for the fact that association tests have shown more emotional and personal responses among the old. The old seemingly tend to hold very tenaciously to whatever they may have left. Having little, they apparently tend to exaggerate the importance of their own chair or of a folded paper. They also tend to resist change, because when a thing has been found to be satisfactory they are loath to seek further. The old accordingly resent any attempt to introduce change. They are less likely to surrender their racial beliefs and forget their clannish enmities. We cannot really say that they are less emotional; but we can say that they face fewer unlike situations in which emotional meanings appear. In those which they do face, they may show emotional products. The stubborn, cantankerous, querulous old man is certainly more than a literary picture. When normal conditions become shot through with senile disorders involving hallucinations and delusions, the picture tends to be more highly colored. Rage against others and sorrow for themselves most commonly appear under these conditions. Murder in the first case or melancholia in the second case may finally result.

G. *Physiological Changes in Emotions*

a. Facial. Some students who have been strongly influenced by biological writers tend at times to regard emotion in terms of various physiological changes involving the face, the viscera (mainly bodily organs), and the limbs. The emotion for some *is* the bodily pattern; for others, emotion merely reflects the bodily pattern. Careful studies have accordingly been made of facial patterns which possibly occur in unlike emotional situations. Landis, for example, secured a large number of photographs of the faces of his human subjects while they were functioning emotionally. Among the various situations that his subjects faced were (1) seeing pictures of normally disgusting skin diseases, (2) hearing musical selections, and (3) getting an electric shock while feeling among a pail of jumping frogs. He could find no scientifically acceptable relation between the photographed facial

patterns and the emotional descriptions of his subjects. In addition to large variations among his human subjects, he found in many cases that an individual apparently had from one to three "general facial patterns" for the several unlike emotions. Some accordingly showed almost no change from situation to situation although very dissimilar emotional meanings were repeatedly reported. Generally speaking, the faces of the women changed less than did those of the men. Another experimenter asked a number of individuals to state the particular emotion revealed in each case by pictures of a human face. The reports were more accurate, for instance, for laughter and contempt than for any others. A high degree of uncertainty ran throughout all reports.[1] Figure 92 shows a method of demonstrating facial changes in emotions. Any one of the four divisions shown here on this wooden face can be changed independently of the others by removing it and substituting in its place another segment which has different lines.

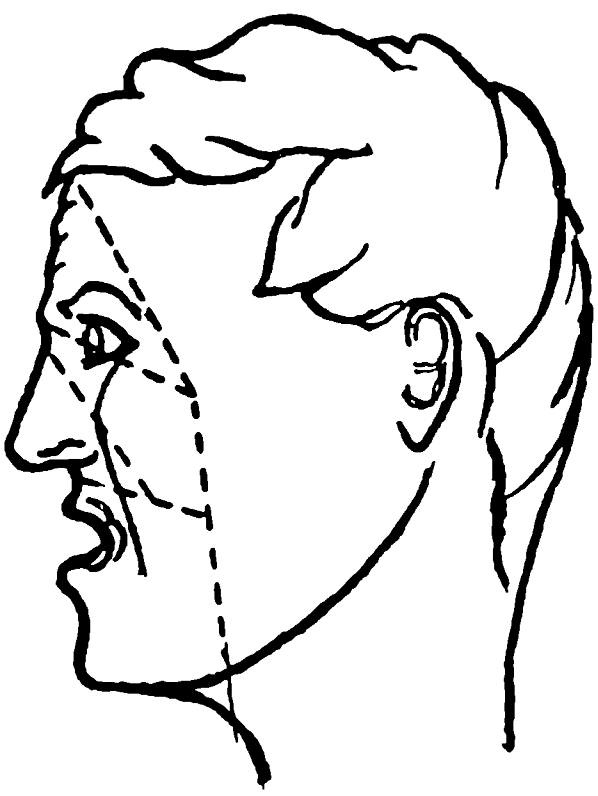

FIG. 92. Sketch of apparatus used in studying facial changes in emotion.

We must accordingly recognize that data gathered from various sources reveal the impossibility of discovering any significant relation between (1) physiological products as represented by the movements and patterns of the human face on the one hand and (2) recognizably different emotional situations on the other hand. The naïve notion that an individual's "Mind" is mirrored in his face is no more true of his emotions than it is of his many other functional traits. Thoughtful students have long since given up the hope of finding an individual's psychological make-up on his face. The extensive experimental work on facial expression of emotions should give the student a better understanding of the nature of man's functional properties. Science must look to the observed situation which is meaningful and to the individual's description of it in order to secure reliable information about emotional functioning. There may be widespread physiological changes occurring in such situations; but, as we shall later show,

[1] See studies by Feleky and by Ruckmick.

these changes have a different significance. If no significant relation exists between emotion and facial pattern, is one to be found in connection with the trunk and the limbs?

Many careful studies have been made upon possible physiological changes in emotion. Men have examined visceral, cutaneous, glandular, circulatory, respiratory, and skeletal products to discover the particular nature of their relations to man's emotions. All such changes are, of course, purely physiological and chemical — not psychological. Lest the student misunderstand, we again point out that the nature of the particular method used in attacking any particular problem necessarily determines the nature of the data (facts) obtained. To test subtle glandular changes by means of a delicate instrument is not psychological. To determine the amount of free sugar in the blood (or bodily excretions) involves a chemical method; and the resulting data are chemical — not psychological. A measure of rate of breathing, for instance, is not a psychological measure.

b. Blood Pressure. Blood pressure has been studied in relation to emotional situations. It has accordingly been found that such pressure may increase in painful situations, while taking an examination, during fear, under shock, in joy, and during anger. The student perhaps recalls that Rip Van Winkle's wife died from the bursting of a blood vessel during a fit of anger at a peddler. It has been clearly shown that comparatively large organic changes may occur *rapidly* under *non-emotional* conditions. As a direct result of this fact, a statistical measure of normal blood pressure has little value in interpreting blood pressure in *emotional* situations. Landis remarks that with the exception of his "surprising" situations, there was none which resulted in any particular form of blood pressure change. Rises, falls, variability, and range are seemingly dependent upon the physiological condition of the individual at the moment of stimulation. They show no one to one relationship to the type of situation. Various attempts to correlate blood volume and emotion have not given very significant results. (By volume we mean an increase in the amount of blood in some member. The student has probably noticed how the veins of his hands swell when allowed to hang down for a time.)

c. Other Visceral Products. Studies have also been made upon the rate and the amount of breathing and of heart beat. One experimenter used a special chair by which he could suddenly cause

his subjects to fall backward (Blatz). He noted a sudden increase in inspiration at the time of falling. The heart beat [1] was also increased in rate and amplitude; it was then retarded to be followed by a second lesser acceleration and a slow retardation. The normal rhythm of beating was disturbed; irregularities appeared.

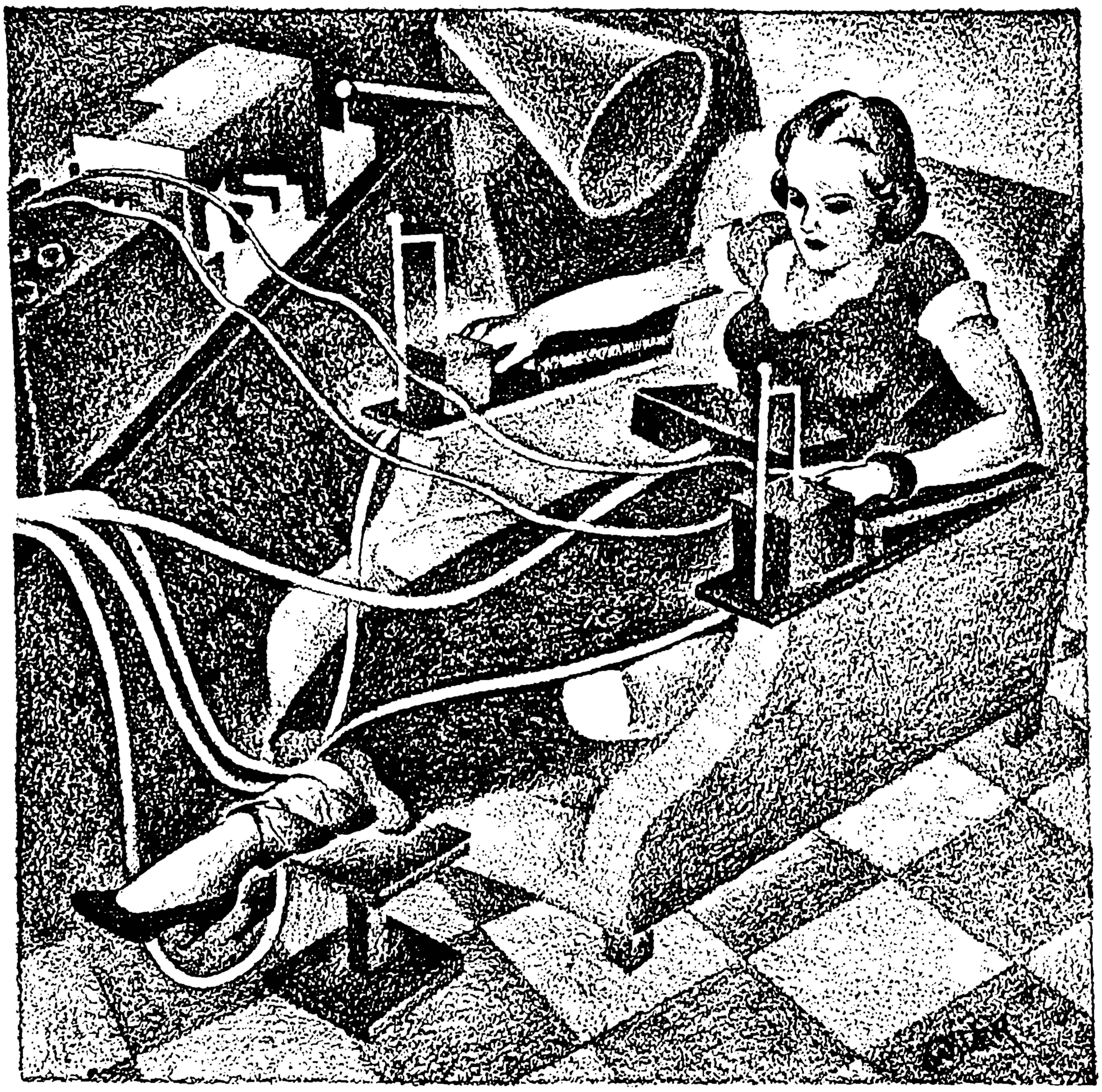

FIG. 93. Some physiological methods of studying organic functions in emotional situations.

Intestinal changes have also been carefully investigated. Cannon and others have shown, for instance, that peristalsis may possibly cease for some time following the observance of an emotional situation. Brunswick has more recently reported certain changes in the stomach and intestinal tract in a number of human beings while facing such emotional situations as fear, disgust, shame, envy,

[1] By photographing deflections of a galvanometer sensitive to the electrical changes in the beating of the heart. Such are called electrocardiographic records.

and delight. Balloons were introduced into the subjects and so connected, by the use of tubes and recording devices, as to produce graphic records of organic changes. The data seemingly indicate that pleasant situations are sometimes accompanied by increased pressure (heightened alimentary tonus) and unpleasant by decreased pressure. Many of the situations, however, were accompanied by neither type of tonic change. Or, such changes might quickly shift from one type to another independently of any accompanying change in the emotional situation. He found no unique changes for each emotional situation. Fear, anger, and disgust, for example, gave the same general sort of record. The experimenter depended in each case here upon the verbal descriptions of the subjects to obtain direct knowledge about the emotional situations. Figure 93 shows one kind of experimental arrangement for studying emotions. The psychogalvanometer is used on the hands to determine electrical charges. Other instruments also reveal changes in breathing (chest) and in blood pressure and volume (leg).

d. Skeletal. There is, moreover, no discoverable relation between the movements of the skeletal muscles — limbs — and verbally described emotional situations. There may be movements of which many are clearly random or non-directive. The individual may shuffle his feet or wring his hands; he may twist or fling himself aimlessly around. In fighting one may run, dodge, kick, strike, pull, gouge, bite, and twist. The particular movements seemingly do not count. It is apparently the *end* — just as in the case of Lashley's rats — that actually counts. The coward may run forward and assume a threatening posture, yet all the time be quite frightened. The drooping posture of despair may be identical with that of fatigue or boredom. Or, the posture of irritation may be similar to that of pride or disdain. Love, too, may show a large variety of postures and movements. The patterns here apparently depend again upon the character of the total situation. If one type is demanded, it may immediately appear and be followed a moment later by another sort. In this connection we note in part a statement by Franz and Gordon that we are not likely to find an emotional differentiation in the direction of hunting for behavior units or pattern reactions. The differentiation lies rather in the general directions of striving which are able to make use of *many specific behavior units* as the latter tend to promote the emotional goal.

e. Cutaneous. Changes occurring in the skin during emotional functioning have been widely studied by means of the galvanometer — a sensitive instrument capable of picking up very slight changes in the electrical resistance of a human being. Woodrow used this method in a study of children's emotions. But he was unable to find any significant relation between the amount of deflection shown on the instrument and the judgments of observers concerning emotional behavior. His data revealed how clearly the same individual varies from day to day in these respects. From his studies with the galvanometer, Landis also concludes that it does not furnish a reliable measure of emotion. The electrical changes recorded by the instrument apparently arise from many different bodily sources. Some changes may occur in emotional situations; others may not. Many students agree, for example, that the sweat glands generally play an important rôle here in causation. It is also agreed that one of the products of muscular functioning is electrical in nature; these products are revealed by the galvanometer. Such changes accordingly have little or no particular emotional significance.

II. *Significance of Bodily Changes*

We commonly assume that cause is not to be identified with effect; that the antecedent is not the consequent. We suggest that this should be applied to our thinking about emotional functioning. In the sex emotions, for instance, we assume that various *bodily* changes (physiological conditions) directly induce changes in neural functioning so that certain situations are then observed to possess particular meanings. The thinking here is also similar to that involved in hunger. Physiological changes of a subtle nature occur in man's body — organs and blood — which directly affect his nervous system as a result of which the observed properties of the organism which are concerned in the perception of hunger emerge. We accordingly hold that certain bodily (non-neural) changes actually stand at times as one immediate cause of emotional functioning — the organism perceives, remembers, or imagines a situation which has emotional properties. In other emotions, we assume that certain bodily changes occur as a direct *result* of neural functioning. We shall later find confirmation of this point in Cannon's work. Such bodily changes must accordingly stand as purely physiological *products* of neural functioning;

as such, they belong in the same categories as reflexes. Such changes either may or may not occur. Their appearance depends primarily upon the momentary condition of the organism. When such physiological products issue, they may or may not be observed in essentially the same way that a reflexive movement may or may not be observed. If they are observed, they may possibly reënforce the emotional situation — they may directly add to it. An emotional situation, in short, is one which always involves an *organism*. Whatever the organism observes may either add to or subtract from its functioning. The perception of the various organic changes may stand at times as an integral part of the emotional situation. The simple fact that some form of instrumentation is commonly required to secure reliable information about some of these changes should indicate in such cases that they are not integral features of the total emotional pattern. Nevertheless, they may serve as causes.

We suggest that animals should also be sensibly regarded as functioning emotionally under particular situations in which they directly observe certain environmental objects. That is to say, we can find no scientific justification for assuming that subhuman organisms must observe subtle bodily changes as necessary factors in emotions. If the situational demand is not too great, man may possibly observe some of these bodily conditions. He may perceive that his legs tremble for a fairly long period after he has faced an emotional situation. They may continue to tremble long after *all observable fear* has disappeared — when the situation has, in fact, turned into a wholly non-fearful one. The organic upset as in this case is certainly not the emotion. It seems to be scientifically necessary, at times, to regard all such physiological products as being secondary changes. They naturally have a cause; but the cause may possibly be entirely non-emotional. A normal individual, for instance, may tremble violently after walking up a flight of stairs or after smoking a cigarette. Those physiological changes which actually serve as causes of emotional functioning are never so obvious. Causation commonly works at submeaningful levels. Man cannot look within himself and discover the *physiological* causes of his behavior. If there is any one cause of this sort, it is surely the brain. Yet man never observes his own brain at work.

I. *Psychological Methods of Studying Emotions*

Emotions may be studied by securing accurate descriptions of every observable feature of some *emotional* situation. This method is identical with that of other sciences where a particular situation is carefully reported upon by observers. When the physiologist, for example, studies the functions of the eye or ear, he usually presents a situation and asks the observer to report descriptively upon particular phases of it. When an individual goes to an oculist for glasses, he is asked to report directly upon the nature of standardized objects which he observes there. By using the method of direct verbal report, the psychologist is able within limits to secure reliable information about an individual in terms of his emotional functioning. If he is working with an abnormal individual who is emotionally disturbed, he necessarily listens very carefully to his descriptive reports. If he is working with normal individuals, he can present a particular situation to a large number of individuals and then require each subject to check, from a possible list, the particular emotional meanings which *emerged.* He can also use standardized association tests such as we have previously discussed and so gather data upon the nature and frequency of emotional responses among different groups. Finally, he can make use of questionnaires and emotional inventories of which several have been standardized. Woodworth, for example, employed such methods with World War soldiers. Matthews has made good use of a modified form of Woodworth's method in studying emotions in children. In such tests, individuals may be asked such questions as: "Are you usually sad in cloudy weather?" "Are you happiest when you are away from all others?" "Are you generally quite sure of what you intend to do?" Medians and other values have been established with such devices and in terms of them a particular individual may be given a comparative standing.

J. *Emotional Control*

We approach here a matter which has considerable personal and social importance. The personal significance of continuously facing an emotional situation has long been emphasized. Unsatisfied longings and emotional stresses have often been cited as causes of general organismic disturbances; while worry and fear may slowly sap the energy stores of an individual and impair his efficiency.

Freud, in particular, has built widely upon the concept of emotional repression. Man's failure to find an adequate expression for his emotions, he alleges, tends to lead him to bitter ends. Some students seemingly find nothing desirable about man's refusal to give "expression" to his desires; dire consequences tend to issue from complete repression. They suggest, however, that desirable consequences may possibly follow an indirect expression along socially approved lines. Thus the emotional energy may allegedly be drawn off, or even diverted into other channels by the process of sublimation. The human organism is accordingly pictured as actually possessing a reservoir of emotional energy which must either find a suitable outlet or distort the organism that contains it. Some students hold, therefore, that serious disturbances in man's various activities must finally eventuate should he fail to discover a satisfactory mode of discharging his emotional burden.

a. Sublimation. We do not wish to minimize the significant part which emotional functioning plays in man's life. It may touch every important phase of it. But we cannot reject fact in order to accept a theory which holds that, if harm is to be avoided, *emotional energy* must be liberated in a particular manner. We cannot believe that man is so constituted that he has a stock supply of *emotional energy* which may be drawn off, as water from a cask, in a variety of ways. In short, we cannot agree with the fundamental position underlying the theory of sublimation, *namely*, the existence of a specialized form of energy. Energy is not earmarked. We find no factual reason to assume that a given sex desire, for example, can possibly be sublimated through sheer exercise or work. Man undoubtedly has many possible and unlike sources of emotional satisfaction. Denied one sort, he normally finds another. In music, love, friendship, art, drink, writing, work, and play man commonly finds his daily sources of satisfaction. He may use some or all of them. The full enjoyment of one certainly does not detract from the pleasure of another. He who works hard may play hard. The loss of one is not sublimated in another. To hold to sublimation, in a strict sense, is to accept a sexual basis for all emotional functioning. Until such a relationship stands upon factual ground we must recognize the theory's actual worth, *namely*, an interesting structure built upon a weak foundation. Sublimation is a concept with which some men conjure; and like all good conjuring, it has its touch of magic.

If sublimation is simply interpreted as referring to the recognized fact that a man may become so engrossed in one activity as to cause him momentarily to disregard others, the term performs a useful office.[1]

b. Restraint at Various Levels. Life, even at primitive levels, very often offers no "adequate" means of permitting expression of desires and longings. Even among animal forms where a few males may possibly dominate all the females within a wide area (horses, sea lions, seals, etc.), hundreds of other males may be kept from *mating* over fairly long periods. Furthermore, the possible *anger* of the unmated males finds no adequate outlet. One of them may occasionally challenge a ruling male, but many actually do nothing over fairly long periods. Throughout various human groups, widespread failure to satisfy desires of one sort or another necessarily occurs — not only with sex, but in many other ways. We duly recognize that each social group tends to limit the behavior of its members. Various restrictions exist in the form of taboos and customs. Order is always necessary for communal living, and order definitely implies restraint. In savage groups, for instance, the penalty for striking another in anger may be death; for theft, it may be torture; and for cowardice, disfigurement and mutilation. Every society, then, raises its hand against complete freedom to act in accordance with passing desire. What the individual may desire, the group may either oppose or grant only under specified conditions. Seasonal groupings, dances, and festivals often represent formalized relaxation of certain group restraints. The abandon which frequently appears at such times may be regarded in part as evidence of the desirability of group control. But control has its undesirable side. Because of the character of those in authority or because of changes in group standards, control may become too rigid. That is, certain symptoms may appear; they may be regarded as signs of increasing conflict. Suicide (as recently in Japan), crime, and delinquency rates may rise sharply. In some groups, as a direct result of emotional blocking, the number of persons entering religious orders may show an unusual increase. There is always a certain percentage of all such cases. Any increase or decrease is significant.

c. Education and Training. Both formal education and informal training aim steadily at effective control of emotional

[1] See Taylor, W., "Critique of Sublimation in Males." *Genet. Psychol. Monog.*, 13.

functioning. Through them, society seeks to establish and define the various social conditions under which man shall be emotional. It would prescribe the proper time and the proper place. Society accordingly seeks to state when it is desirable for one to cry or to sing; to love or to fight; to frown or to approve. In all such cases, the emphasis is clearly socialized; it is not personal. Thus control has generally to do with facial and skeletal patterns. Society really does or cares little or nothing about visceral, circulatory, and glandular changes. Man may become very angry, if he does not affect, molest, or destroy environmental objects; he may be afraid, if his action patterns remain unaffected; he may love intensely, if such loving does not *interfere* with other human beings. As every individual knows, emotional control in various forms is constantly exercised. Control issues directly from the very nature of meaningful life situations, from the direct influence of other human beings, and from various functional products, especially the imaginational and memorial sorts. Recognized physical and psychological limitations to one's abilities serve always as emotional controls. Thus the realization of any sort of inadequacy may serve as a control as well as a source of emotional situations. In many cases, an intelligent understanding of possibilities will itself furnish adequate control. The sensible person does not desire the impossible. Control comes through instruction. Individuals are causally prepared, as a result of what happens at one time, to function in a particular manner at another time. We may well consider both the appearance (emergence) and the persistence of such *new causal factors* as representing a form of learning.

d. The Rôle of Values. Individuals are clearly controlled emotionally in a vast number of cases merely by directly controlling the factor of desirability. We assume that emotional meanings arise only in those situations in which something is desired — where an object (end, standard, etc.) which possesses personal significance is affected either favorably or unfavorably. We know that, without value, there is no emotion at the human level. If an individual places no value upon his life, or if he is wholly indifferent to the *Unknown Beyond*, he will have no fear of death. By removing (depreciating) particular situational values, or by substituting different values, or by discovering new (additional) values, man constantly guides himself and others. An emotional situation may actually be caused to disappear *instantly* by such shifts and

changes in values. The poet must have intended as much when he wrote: "The good, the true, and the just — take the charm forever from them and they crumble in the dust." When any form of directive agency — parent, teacher, leader — has successfully established socially desirable values in the various major life situations which a developing individual must necessarily face, it has served its most useful office; it can, in short, do no more. It cannot actually wipe out *inherent* and *basic* conditions for emotional functioning. No sensible agent would, if it could. Emotional control simply does not touch such basic conditions. We can understand, therefore, that under *new* or different situations, emotional properties may instantly emerge, although in the *old* situations the individual may still possess a form of functional preparation that guides and sustains him along socially desirable lines. Let us note, therefore, that emotional control must always be indirect — it must, for instance, work through values. To control value is to control emotion. We must try to cause an individual to evaluate situations, to recognize there is always a proper time, and to place values upon particular things. We recall here Dickens' story of the gentleman who could not be insulted by a peasant.

e. Situational Changes and Understanding. Other forms of emotional control also involve situational changes but in a slightly different way. If an individual can be caused to observe *another* thing, which is either non-emotional or emotional, the particular emotion will disappear or decline. "Distraction" unquestionably does useful service in this way both at animal and human levels. Man can, in this manner, actually whistle up his courage. He can also find new interests of a varied sort. He can normally change some forms of emotional functioning merely by changing scenery — new situations mean new things. Many individuals have been greatly changed by being shipped to wholly new conditions. Thousands of illustrations could be drawn from the sick, the criminal, and the lovelorn. We do not imply, however, that the individuals of these cases cannot function emotionally. Under other conditions, they may be just as emotional. But the old situations have become ineffectual. When such changes are either impossible or undesirable, one emotional situation may actually be substituted for another. Anger may be instantly dissipated by the threat of punishment, and love often finds a strong enemy in

disgust. As men fight "fire with fire" so do they also pit emotion against emotion. *But they do this always through situations*, which may be perceived, imagined, remembered, or understood. Understanding, as we have said, may readily produce emotional out of non-emotional situations. But it also has an opposite effect; it may actually destroy. Where certain emotional meanings exist, a more adequate understanding may so change the situation that they can no longer emerge. Worry, for instance, cannot be removed by sheer command; we may order it to go, yet it stays. We can usually remove it, however, by understanding as clearly as possible the nature of the causal conditions and by recognizing that when man has done his very best under the circumstances, nothing more can be expected of him. Many of us readily quiet our troubles in this manner. Because he is able to understand, the normal adult does not fear many situations that the child ordinarily does. A most outstanding way of destroying undesirable emotions in children is through an appeal to their understanding. To lack such an ability is to live at an animal level. In order to prevent mating and fighting among animals which lack understanding, man must use preventative methods seldom employed with human beings — a fact which the student may thoughtfully consider. Undesirable sex emotions in the immature human being may often be greatly changed through understanding. Moreover, understanding may actually perform wonders at the level of therapeutics. To clarify a troublesome situation is to neutralize its emotional characteristics. Man repeatedly goes for aid and guidance to those individuals in whom he has confidence. They calm his fears and relieve his worries. Very often his emotional situations are as a toy balloon which they prick as expertly as a physician may lance a throbbing boil. The relief in the one case may be no more real than in the other case.

f. The Place of Drill. We have spoken of those who "lose their heads" in situations. The various causal factors here are quite numerous. Upon finding themselves in a situation in which they cannot act as they may desire, anger or shame or disgust may emerge. The angry individual may strike out, push and pull, swear or grit his teeth. The writer has often seen students become angry while trying to master an ordinary maze. They may suddenly drop one mode of procedure and take another which is more forceful. Emotional *disruption* — "losing head" — may

come simply because of the very multiplicity of things which one may try to observe. In case of fire, an individual may start to do one thing only to see something he believes to be important, which he then tries to do. He actually wants to do too much in too short a time. It does not follow in such cases that the individual is more emotional than another who proceeds to carry out some task as rapidly as he can. Emotion does not necessarily imply disruption. To prevent undue confusion and disorder, fire drills are regularly held in every efficient school, in theaters, and on ships. In the latter case, for instance, every individual clearly understands his own particular task. He has his particular station and until ordered he must not leave it. When the situation demands, he can go to his place and carry out his tasks in a dependable manner. But all the while, he may be greatly frightened. Heroes are not creatures who are devoid of all emotion. It is reported that as the *Titanic* slowly turned its broken bow down and slid beneath the North Atlantic, it carried with it a group of heroic bandsmen who knowing they had but a few minutes to live played on to the very end. In closing, we suggest that we know emotions only in terms of situations; we end emotions by means of situations; and we control emotions in terms of situations. Those who lack an adequate understanding of life affairs may say that only the weak allow emotion to become their master. But those who have understanding know full well that only the particular *situation* can actually reveal the nature of the master.

K. *Explanation*

The critical moments of man's life are often his emotional moments. His major values are more often emotional, not intellectual. Considered genetically and personally, man's emotion antedates his thinking. Functionally speaking, he finds in emotion his clearest relations to subhuman forms. Such functions, we suggest, are very old. Man possesses desires before he does understanding. Out of the satisfaction or non-satisfaction of his desires arise his emotions. His desires, therefore, are both caused and causative. Darwin, for instance, has pointed out the significant rôle of sex emotions as causal agents in natural selection. Others have suggested that fear served as a primary cause of man's becoming socialized. If primitive man had been as self-sufficient as the huge ape, he might have been as solitary. Viewed widely,

emotional functioning holds undisputable claim to a place of paramount importance in life affairs of animal and man. It is not surprising, therefore, to discover that science has diligently sought to understand the nature of this functional property of man and beast. We have now to consider this problem of causation. We shall consider the viscera, the autonomic nervous system, and the central nervous system.

a. Viscera. Men have sought at times to reduce emotional functioning to visceral changes and their several effects. The locus, they suggest, of love and hate, or of joy and sorrow lies in the intestine, the heart, the lungs, and the endocrine glands. The latter are the ductless glands (not like the liver with a duct leading to the intestine) which pour their substances directly into the blood. Such endocrine glands — as, for example, the thyroid and the adrenals — function and their several products, which contain hormones (subtle chemicals), spread widely over the whole organism to affect it in many unlike ways. Quite early, two men (James and Lange) formulated a theory of emotions which found wide favor in science. They suggested, in part, that (1) the stimulating situation acts upon the organism (2) to produce directly various physiological changes, particularly in the viscera. In the third stage (3) man becomes *conscious* of these physiological changes; and his consciousness of these particular bodily conditions is the emotion. The body allegedly acts upon the mind and the resulting mental effects constitute the emotion. Each emotional stimulus produces a unique, *specific* physiological pattern which is in turn reflected in the mind in the form of fear, anger, love, or hate. If an individual should suddenly find himself trembling in a fearful situation, the trembling is not *due* to fear. On the contrary, he is afraid simply because he is trembling. Should he not happen to observe either that he is trembling or that some other bodily property peculiar to fear exists, he would not be afraid. This theory implies that a fearful organism (a rabbit or man) "introspects" or consciously notes these various changes in bodily pattern. Instead of observing the fearful object or situation, it observes its beating heart or its moving legs. We would be wholly unable to accept such an explanation if on no other grounds than that it demands too much of animal or human being. It asks either that it disregard the emotional situation in order to observe internal changes or that it regard both at the same time. The angry or

fearful organism certainly does not *disregard* the emotional situation. An organism running from an enemy will be repeatedly seen to turn and look in the direction of the fearful object. And, it is indeed difficult to believe that the organism observes properties of environmental object and properties of itself (trembling legs) at the same time. There are, however, other cogent reasons for rejecting this *physiological* approach to emotional functioning.

The results of careful investigations by Cannon and by Sherrington stand opposed to any such theory. Both are *physiological* scientists. Using standard physiological methods, Cannon was unable to find a specific bodily pattern for each specific emotion. Instead, he discovered only a very generalized pattern in cases of *strong* emotions (rage and fear), in pain and in excitement. This pattern included the secretion of adrenin, an inhibition of gastric functions, and the secretion of tears. Regardless of the particular environmental situation, these same bodily products were found. It was evident, therefore, that other determining factors must necessarily enter in order to account for the striking differences found among emotions as given *in terms of observation.* If tears appear in joy, sorrow, rage, and pain, tears cannot constitute the emotion. This is equivalent to saying that if one runs at one time in fear and stands paralyzed at another time, neither the running nor the paralysis is the emotion. But Cannon went even farther. He injected large doses of adrenalin into non-emotional organisms, both human beings and animals. His physiological tests then revealed such visceral changes as increased heartbeat, cessation of gastric functions, and increased amounts of sugar in the blood. But not one emotion was reported by his human subjects. His animals could not report verbally; but there was, for instance, in his cats, no striking, no spitting, no arching of back, and no hissing. Not one single action, such as may daily appear in normal emotional situations, was observable under these conditions.

Cannon accordingly suggests that emotional functioning as far as *behavior in a situation* is concerned is independent of all such purely visceral changes. He suggests, moreover, that emotion definitely arises *before* bodily changes. The bodily products issue more slowly; they follow the emotion. We suggest, therefore, that *emotional meaning comes before bodily movement.* We may note a remark of Cantril's who used adrenalin with human beings: the awareness of some object or situation around which the emotion is

intellectually organized is the immediate cause of the emotional experience as reported by our subjects. The situation might be distinctly *unpleasant*, although the subjects might report a *pleasant* tingling in the arms, neck, or chest when permitted to observe.[1] Bodily reverberations of the situation may unquestionably be discovered. But they are both secondary and accessory. They are not vital factors in emotion. Cannon himself regards some of these visceral changes as being biological devices for furthering the organism in another way. The adrenin, for instance, releases sugar from the liver, thus supplying more energy if it is needed; it hastens coagulation of the blood, if wounds occur; it neutralizes fatigue products, thus permitting greater effectiveness; it induces sweating, and so removes excess temperature; and it tends to drive the blood (stops digestion) to the skeletal muscles and away from vital organs. These particular changes are purely biological. They run entirely at a submeaningful level. An individual does not observe an increase in the sugar content of his blood or a cessation of gastric functioning. Such changes, therefore, would not fit into the James-Lange picture of the physiological approach to emotion. Yet they are actually the common physiological changes in emotional situations.

b. Autonomic Nervous System. The visceral functions are always governed in part by the autonomic nervous system. The latter consists of a connected series of nerve centers some of which lie outside while others lie *within* various visceral organs (Fig. 94). Regarded in terms of its function (not structure), the system breaks up into three gross deviations, *namely*, the cranial, the sympathetic, and the sacral. Autonomic fibers of these divisions reach to all regions of the body. Over these fibers, neural changes pass at a much slower rate than over the fibers of the central nervous system. This division of the neural system is partly controlled by the central nervous system. It is also partly *self-governing* — thus the term *autonomic*. Energy changes initiated in the brain may involve the autonomic pathways leading to various bodily organs and so determine the various physiological products — glandular secretions and muscular movements — which appear at any given moment. But in the absence of cortical control, the autonomic system may serve as a causative factor in the regulation of organic functions.

[1] See also Cantril, H., and Hunt, W., "Emotional Effects Produced by Injection of Adrenalin." *Amer. Jour. Psychol.*, *44*.

It serves independently of the brain, to produce goose-flesh, to lift hair as on a dog's back, to govern dilation and contraction of organs (pupil, blood vessels), and to increase or decrease the rate of glandular functioning. This system is not only very complex, but it may produce directly opposed results. The cranial division, for example, may decrease heart functions and increase activities of the alimentary canal (see Fig. 94). The sympathetic region, however, may increase heart functions and inhibit alimentative functions.

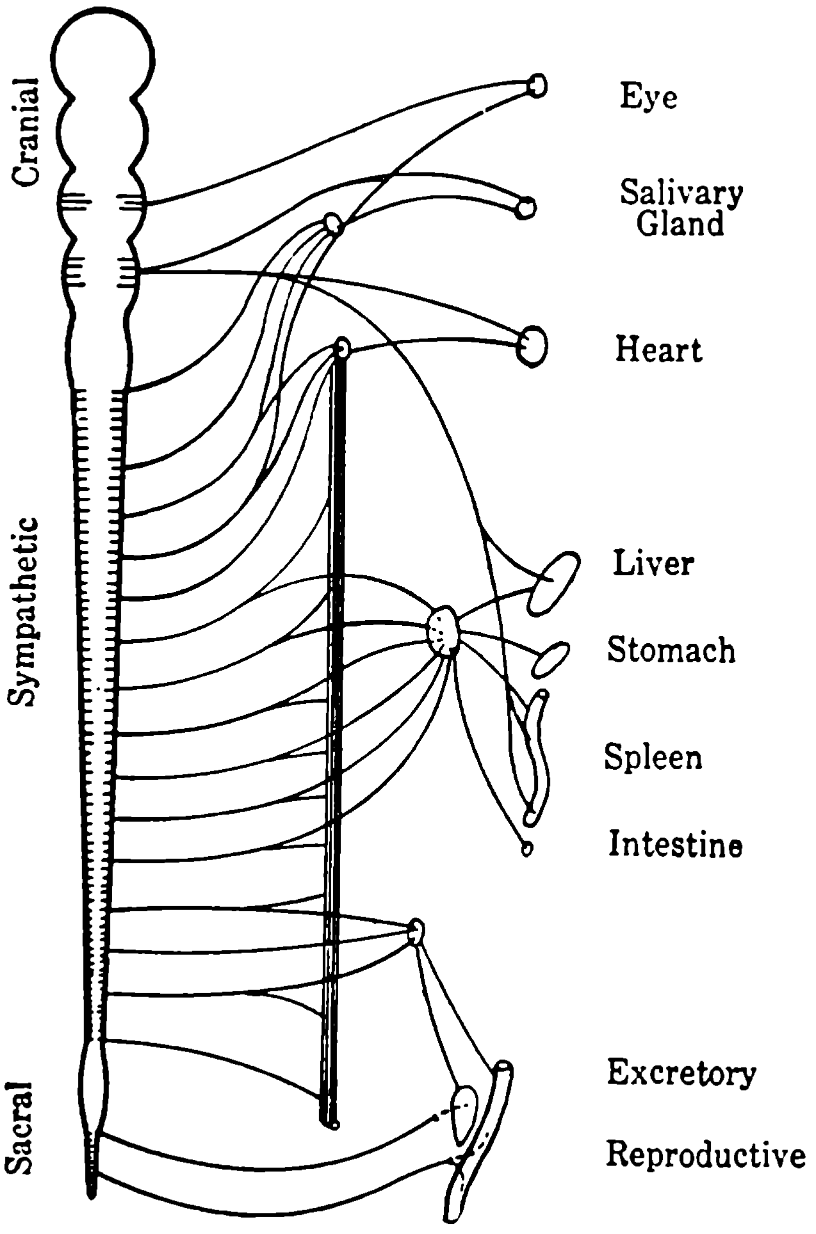

FIG. 94. A sketch of the autonomic system.

Some interesting and significant data have been gathered upon emotional functioning in organisms with neural lesions (breaks). Cannon, for example, removed the sympathetic division as far as *function* was concerned. His animals (cats) upon facing dogs behaved in a wholly normal manner — they snarled, hissed, struck, and arched themselves. His results were quite unambiguous. In the complete absence of various visceral functions — held by many students to be inseparable, causal factors in emotion — the animals exhibited no change in the way in which they had previously met certain situations. Sherrington's results obtained from dogs were just as striking. He eliminated visceral functions by cutting the nervous system in the cervical region. His dogs behaved as they previously had. They were seemingly angered at strangers; and pleased with former friends. Sherrington also used puppies which had been carefully guarded against meeting emotional situations. After their operation, they were brought into emotional situations. Emotional behavior instantly emerged. From his extensive studies upon the rôle of visceral functions in emotion, Sherrington concludes that these physiological factors are not, in any sense,

necessary components of emotion. Emotional functioning may proceed independently of heart, lung, gland, and stomach activities. Physiological changes may, of course, appear; but they must be regarded in one sense as being by-products. They are roughly comparable to the wastes which appear in some manufacturing plant.

Such results from experimental animals may be sensibly interpreted in the light of descriptive reports of human beings who, as a result of disease or injury, may suffer extensive lesions in their spinal cord. Even under complete bodily paralysis, induced through broken spinal cord, emotions of various kinds have been reported. Control over *voluntary* movements may disappear, yet emotion still appear. Recently an old paralyzed man reported the pity and horror which he endured for three days while helplessly looking at the body of his dead wife lying on the floor beside his bed. In epilepsy and under the influence of drugs, there may be shouting, groaning, screaming, and laughing without the slightest evidence of emotion. That is, those portions of the nervous systems which lie below the brain may produce many *physiological* changes — they may function in various ways — in the apparent absence of any emotional functioning.

c. Brain Functions. It should be apparent from what we have said here that science must regard the brain as being a major causal factor in emotion. We must assume that the brain functions in a particular situation and emotional meanings directly emerge. But the observed situation itself must be regarded as being as important as the brain. Because of man's inherently determined constitution, he is equipped to function in certain ways in certain situations. Emotion is one such functional property of man which reveals itself under various situational conditions. The ability is laid down by heredity; but, lacking a situation, it would never appear. To cite a chemical analogy, acidity is a functional property which can be revealed only under particular conditions. Lacking these conditions, there would be no acidity. As we pointed out in Chapter II, the emotion of fear emerges when an organism faces a situation in which a painful (harmful) object is observed. Man is so made that he must, at times, be emotional; the nature and the frequency of his emotions accordingly depend upon his heredity, upon his personal history, and upon the particular situation which he faces at any given moment.

If he can remember or imagine particular situations, man may experience as much emotion as when he perceives a situation. The particular *mode*, therefore, is not so important; but the nature of the *meaningful* situation is.

This emphasis upon the brain, rather than the body, finds ample justification in the experimental studies of Sherrington and Cannon, each of whom has definitely concluded that first the brain functions and then emotional products appear. After brain function, there come emotional meanings. Cannon, for example, assumes that a particular region of the brain is functionally necessary for emotion.

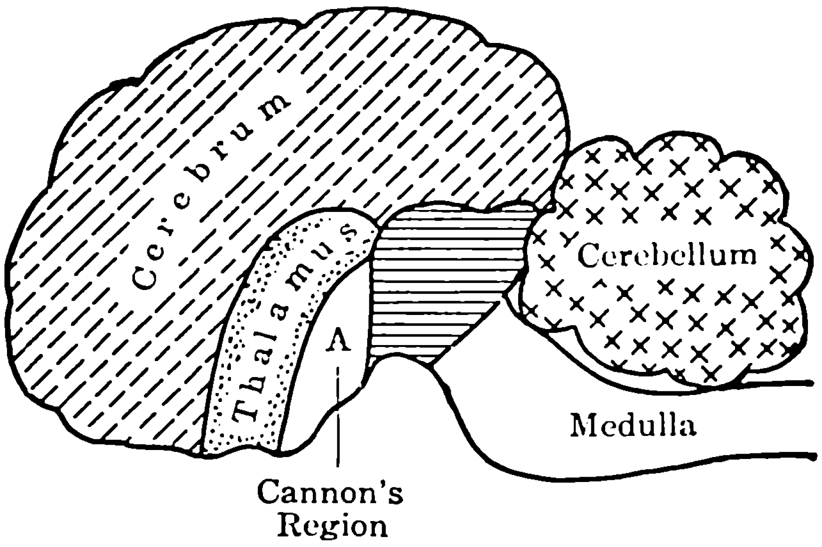

Fig. 95. Emotional functioning is brain functioning.

This region he localized in the thalamus. Figure 95 roughly shows some portions of the brain of an animal which may be cut away without destroying emotional functioning. When *A* is destroyed, emotional behavior disappears. As long as this portion of the thalamus remains intact, even though the viscera can play no part, some emotional functioning is possible. When the thalamus is destroyed, emotion is lost. From the thalamus, Cannon suggests, energy may pass out to bodily regions to produce various physiological changes. But such are secondary. The cortex directly controls the functions of the thalamus as far as emotion is concerned.[1] By means of his cortical functions, man observes (perceives, remembers, etc.) a particular situation. Energy may possibly be released to affect the thalamus. If it is not released, there is no emotion. In this way, the cortex controls the emotional functioning of the organism. The cortex reaches out in two directions. It produces meaningful situations (psychological

[1] When the cortex is impaired, organisms tend to become more excitable and unstable. Two cases of partial brain destruction in human beings have recently been reported. In each, the major symptoms were emotional. The individuals were more boisterous and erratic.

products), and through the thalamus it produces physiological products.

L. *Pleasantness and Unpleasantness*[1]

a. Nature. Objects appear, from an individual's *earliest* moments, to possess certain properties in terms of which they may be either accepted or rejected. The hour-old infant, for example, will unquestionably refuse substances which are bitter or sour. Such things, we definitely assume, are unpleasant to the infant as they are to the adult. As soon as the child acquires a vocabulary, it reports such bitterness and sourness. Similarly, we hold that painful objects are unpleasant in the very beginning and that they persist unchanged in this respect throughout life. When sensibly regarded, unpleasantness or pleasantness will be considered as being a *meaningful* characteristic of an object; as being a psychological property which is directly observable at all age levels. That is, it is not something which suddenly emerges, for example, when an individual has reached one year of age and which gradually develops (increases) through the years. This is what Carr implies, we assume, when he states that pleasantness and unpleasantness are inherent attributes of sensory objects. Such psychological properties are wholly elementary and irreducible; they cannot be shown to be complexes or patterns. Moreover, they are no more derivable from non-affective characteristic, than specific gravity of gold, for example, is derivable from its color (yellowness). These properties emerge immediately under proper causal conditions and take their rightful place as unique characteristics of some thing. They are not merely matters of theory; they are directly observed. They are identical in this respect with other psychological characteristics. They may be, moreover, as independent of training as any other psychological property, such as sweetness or redness. Sweetness, for instance, must appear under certain conditions, and so must pleasantness or unpleasantness. Man does not need gradually to learn that sweet things are pleasant and bitter things are unpleasant. Such properties are meaningful characteristics which he may observe from the very beginning and *which may persist unchanged during his lifetime.*

[1] See Young, P. T., "Pleasantness and Unpleasantness in Relation to Organic Response." *Amer. Jour. Psychol., 32;* also Nafe, J., "The Psychology of Felt Experience." *Amer. Jour. Psychol., 39.*

Regarded as observable characteristics of an object, pleasantness and unpleasantness may exist side by side in the same way that two different color properties may be simultaneously present. An object may accordingly be visually pleasant but auditorily unpleasant; it may be pleasant to smell but unpleasant to taste. An ordinary landscape may contain within it both pleasant and unpleasant objects. The one side of a human face may be very pleasing but the other side may be very displeasing. We consider these psychological properties, therefore, as being forms of meanings — not mental elements or bits of a human mind. We regard them as being directly observable and distinguishable properties of objects either human or non-human. They belong to the things of the world just as much as does color or size. They are actually no more mental than the characteristics of a plant (flower) which the botanist describes in terms of color, odor, size, and shape are mental. Regarded causally, pleasantness and unpleasantness depend, it is unquestionably true, upon a functioning organism. But so does the color and shape of the flower, the odor of carbon bisulphide, and the yellowness of sulphur. Nothing can possibly be added to our scientific understanding by suggesting that these affective properties are *subjective* but that non-affective properties are *objective*. All psychological characteristics are dependent upon a human organism which functions within a situation. We do not wish to perpetuate a distinction between subjective and objective.

These properties are, moreover, definitely localized. In the case of quinine, for instance, the unpleasantness is unquestionably as specific to it as its bitterness is. If the unpleasantness is not localized, then ordinary spewing behavior is indeed difficult to understand. Only the short-sighted theorist would possibly contend that such properties cannot be properly regarded as belonging to an observed object or situation. We do not imply here that one property is always independent of other properties of a similar nature (physical, chemical, psychological). For example, the acidity of a substance may change instantly with a change in temperature. Similarly, the pleasantness of an object may shift under a change in its other characteristics. It may, however, persist relatively unchanged so long as other changes are held within limits. A bit of food may be very pleasant when one is hungry. But as hunger is appeased, the pleasantness tends

gradually to decline. Or, a whispered warning that a pleasant drink contains poison may instantly change it. To a very thirsty man, however, the taste of water may vary considerably without impairing its pleasantness.

b. Significance. The affective properties of objects play an important rôle in life affairs. They normally serve as selective determiners; objects are either accepted or rejected in terms of these psychological characteristics. Regardless of the nature of a particular object — whether it be nutritive or aesthetic or sexual — we must recognize the significance of its affective character. In the preparation of food, in the production of artistic objects, and in the selection of mates, the factor of affective value directly enters. Its influence was clearly indicated by Darwin in his discussion of sexual selection at the animal level. Within limits, each animal either male or female tends to select a mate in terms of particular characteristics which carry an affective weight. The less pleasing are eliminated; the more pleasing are perpetuated. What is pleasing or displeasing depends in part upon the organism and in part upon the object. The perpetuation by a species of particular characteristics thus rests upon a definite psychological foundation. It was so recognized by Darwin. Selection definitely tends to proceed at an observational level; among other things, it involves differentiation among meaningful properties. It involves what animal as well as man may perceive.

Man commonly tends to seek out, to use, and to preserve those particular objects which are pleasant — which give him pleasure. At the same time, he tends to avoid, to discard, and to destroy those things which are not pleasant — which do not give him pleasure. We definitely assume that back of each significant decision upon life affairs stands a determining affective factor. Man necessarily proceeds toward the realization of certain *ends;* in fact, the maintenance of life itself rests directly upon the satisfaction of inherently determined desires. The hungry individual strives toward food: the thirsty, toward water; and the weary, toward rest. But there are many goals which extend promise of pleasant reward. Man struggles on toward these, sustained and guided on his one side by pleasure and on his other side by displeasure. He may momentarily take that which is unpleasant because rejection would block his way to other pleasant things. We accordingly find that the course of life definitely tends always toward one outstanding end,

namely, to secure that which is pleasant and to avoid that which is unpleasant.

Happiness we hold to be the major psychological end of life. Each individual in his own way exemplifies this truth. Miser and spendthrift, drone and worker, saint and sinner, restless youth and calm senescent — in each, we find objects taken or rejected in terms of their affective characteristics. Here is a common meaning that runs through all life patterns — among animals, little babies, and adult men. In terms of this common *causal* condition, we find a clue to universal similarities at different levels. The behavior involved in playing, eating, sleeping, drinking, resting, and sex issues from meaningful situations. The satisfaction is psychological. We do not imply that there is no *biological* basis for such patterns. But we do suggest that all such determining conditions, whatever their nature, are unquestionably submeaningful. They serve as causal factors at a non-psychological level. Man plays because it satisfies him under particular situational conditions. He does not play because of some unobservable physiological, chemical, glandular or muscular condition. If the behavior patterns of the raving maniac cannot be scientifically referred to purely biological conditions, we can scarcely hope to do so in the case of ordinary behavior. In this connection, we take guidance from Carlson,[1] who remarks that "unfortunately, there has been a tendency to emphasize the endocrines or hormones as causative agents in human behavior and to put them in the place of the spirits or demons of several centuries ago."

c. Relation to Other Properties. It is widely recognized in science that, *within limits*, certain properties of substances are related. A change in a substance that affects one also tends to bring a change in another. Density tends to change with temperature; specific gravity with distance from the center of the earth. Affective properties may also change as shape, size, familiarity, color, taste, or emotion changes. An object may be pleasant at this moment; but unpleasant or indifferent at the next moment. A change in any phase of the total situation, either in the functional organism or in the object observed, may produce such shifts. A human face which is now pleasant may be shortly unpleasant. A source of energy may remain wholly unchanged; but the function-

[1] Physiology Department, University of Chicago. In *Problems of Mental Disorder,* p. 240.

ing organism may change and so bring about a resultant change in affective product. When man grows tired, many formerly pleasant objects may become unpleasant. A shift in some non-affective meaning, regardless of its cause, may be directly accompanied by a shift in affective meaning.

We do not assume that a physical or chemical stimulus first arouses unobserved sensations and that these *sensations* may then be either pleasant or unpleasant. On the contrary, the latter are as immediately and as directly observable as color, size, and familiarity. They emerge as unique characteristics of things. Man may perceive, understand, imagine, or remember some object which is pleasant or unpleasant. We must agree with Carr that objects may be things which we either like or dislike. As functioning adults, we may no more know why we like or dislike a *perceived* thing than an infant knows why it dislikes sour substances. We are also able to *remember* many things in terms of various properties. Among these properties may be feeling. Furthermore, we cannot find the slightest evidence that man is unable to remember affective properties. Pleasant situations may be produced memorially as well as perceptually or imaginationally. Affective properties may appear as readily as does remembered size or shape or color.

d. Methods of Studying. The affective properties of objects can be studied through direct observation and verbal report. Environmental objects may be observed by individuals under the definite instruction to consider merely their pleasantness and unpleasantness. In this way, various objects may be experimentally studied in terms of their affective characteristics. We do not imply that *these affective properties* are first isolated or cut away from an object and then studied. We would scarcely expect this sort of analysis in psychology, if it cannot be done in physical and chemical laboratories. No one has separated specific gravity from all other things; it is a situational phenomenon. No one has ever isolated life; in fact, the biologist merely attempts to study living organisms. Any science, however, can consider a thing *abstractively.* That is, it can disregard (within limits) certain characteristics in order to regard other characteristics. Man may report upon an object, as in the case of an automobile, yet be unable to describe its color. He can also abstract an object's affective properties and report directly upon them. A subject may be asked

to observe while being stuck with a pin or shocked with electricity; while ice is applied to his back or hands; and while he eats burned cabbage or delicious dessert. There is no more justification for assuming that the affective properties of substances cannot be steadily observed (as some say "attended to") than there is for assuming, for instance, that the unpleasantness of a toothache or of a cramping muscle cannot be directly observed without destroying it. As a matter of fact, man does deliberately prolong in a great many cases the observable pleasure derived from particular objects.

In this connection, a student remarks that one must distinguish between attending (1) to stimulus or to the sensation and (2) to the mere accompanying pleasantness or unpleasantness. If one thinks of feeling as an effect of attending to a stimulus, he says, it should follow that when attention was not fixed upon the stimulus, at least one condition of feeling would disappear, and the feeling with it (Pillsbury). In short, we can say that if an individual does not observe a thing (either outside or inside himself) there will be no properties to be observed; for psychological properties characterize objects. The student will be properly guided here by recognizing that if an individual while crossing a street is closely observing a particular object (perceptually, memorially, or imaginationally), he actually may not observe a huge truck until it knocks him down. In fact, when close observation of an environmental object is absolutely demanded, one may momentarily lose all pain in an injured or diseased region. But a moment later, he may again observe the pain. We certainly would not say the pain was there all the time if it was not observed. It simply emerges under proper conditions — and one condition is that the organism shall not be engaged in observing something else. Similarly, if one turns from the *direct observation* of the pleasantness of his dessert to a consideration of a theoretical pleasantness, the pleasantness may very well disappear.

In experimental study, various objects may be presented to observers in such a way that each is paired with every other object. At one time, object *a* will be presented before *b* (or on the right); in another time, object *a* will be presented after *b* (or on the left). This method, which is known as that of *paired comparisons*, allows for a large number of observations upon a group of selected objects. From an examination of the results, the most pleasant

to the least pleasant (or the most unpleasant) may be determined. Objects may also be arranged in a serial order from most pleasant to most unpleasant by asking a number of subjects to rank each or to place each in its proper place in the total series. The object which is placed first the most times is regarded as being most pleasant; the object which is placed second the most times is regarded as being second in degree of pleasantness, etc. When large numbers of human subjects are used, uniformities clearly appear. If the subjects are selected in such a way as to represent a sample of the total population, what holds true for them should hold under similar conditions for other similar groups.

e. **Explanation.** Numerous attempts have been made to discover an adequate set of causal conditions for the affective properties. In this quest, men have variously looked (a) to stimulus, (b) to sensory equipment, (c) to visceral changes, (d) to energy levels of the total organism, (e) to thwarting and facilitation, (f) to beneficial and harmful conditions, and (g) to an inherent condition handed down through evolution. (a) Since we do not assume that man responds psychologically to stimuli in terms of their physical and chemical properties, we can properly place the stimulus in the causal picture. As we know from many thousands of illustrations, physical energy may act upon the functioning organism and out of the resulting changes may issue pleasantness, indifference, or unpleasantness. In this connection, we are told that "feeling does not come directly from the external stimulus, but from some organic change which the stimulus brings about" (Warren and Carmichael). As we have repeatedly suggested, this holds true within limits for *all psychological* properties — not merely for pleasantness and unpleasantness. (b) Moreover, the *same* sense-organs may be affected to give either pleasantness or unpleasantness or indifference. We really possess little specific knowledge of the rôle of such organs as far as many *non-affective* properties are concerned. It is, for instance, impossible to account for distance, familiarity, dizziness, pain, roughness, warmth, and tickle in terms of particular or specific sense-organs. But no knowledge whatsoever exists concerning the part (if any) which sense-organs actually play in causing the affective properties. Tickle, for instance, may be very pleasant one moment and unpleasant the next moment.

(c) Moreover, no scientist has been able to show any causal relation between bodily (visceral) changes and the feelings. It is

quite possible that such physiological products may actually have *no biological* significance. They may be purely "accessory" and non-useful products. Biological existence does not imply biological usefulness. In fact, many structures and functions actually exist but serve no biological end. Certainly, visceral conditions cannot be set as antecedent factors of affective properties. (d) It is true, at times, that a condition of fatigue (loss of energy) may be accompanied by a greater degree of unpleasantly characterized objects and situations, yet we find many persons whose energy level is greatly lowered, as in tuberculosis and cancer, who show no such affective tendencies. If mood could be reliably related to man's energy stores, this matter of causation would be greatly clarified; for particular moods seem either to cause or to be accompanied by particular affective properties. Feeling may actually be one symptom of a mood; as such it would not, of course, be the result of a mood. (e) Science has not been able to show any significant relation between (1) thwarting (or hindrance) and facilitation (or furtherance) and (2) man's feelings. Pleasant objects cannot be shown to benefit or further the organism, unless the evidence is hand picked and many negative cases disregarded.

(f) Some students would say that those things which please are good and that those which displease are bad. But we know that some drugs, poisons, and foods may be both pleasant and injurious, while other kinds may be both unpleasant and beneficial. The student will do well to understand that what is harmful or non-harmful so far as affective properties are concerned is essentially a matter of *meaning* — not of physiology or biology. It may be unpleasant under certain conditions to have another scowl at us; even though it is difficult to show any biological harm. In fact, the scowl may be pleasant, if it leads to satisfaction. The student must not confuse psychology and biology. He must recognize the limited value of a naïve *biological* approach which assumes that the psychological properties of pleasantness and unpleasantness *must* necessarily possess survival value. This is neither good logic nor biology. We may readily grant that such things are evolutionary products. But this does not force us to find some survival value in them; they do not need to serve *biological* ends. We have said that there are both structures and functions (e.g., grasping) in man which are seemingly non-utilitarian. We can properly understand that man has unlike desires of which many have a very long history.

The satisfaction of these desires — both good and bad in a non-psychological sense — is undoubtedly pleasant. On the other hand, the failure to satisfy them is unpleasant. Man unquestionably knows that he has his desires, but he does not know why in terms of biology. He also knows that satisfying such desires tends to please him. He likes to be pleased; but again he does not know *why*. He seeks to be pleased rather than displeased because he is inherently determined to do so. Both desire and pleasant satisfaction proceed at a psychological or meaningful level. There seems to be no end other than sheer satisfaction. Pleasure is unquestionably sufficient in itself; no goal lies beyond. Here is where activity ends in man and in animal.

(g) We must assume, therefore, that man's affective values directly issue from an inherently determined basis. They have had a very long history; they arise from the very nature of his protoplasm and the several changes which necessarily occur in it during his personal history. The affective properties of things serve as an *end* in themselves. To deal with certain objects is at times pleasant; to avoid other objects is also pleasant. We suggest here, by way of illustration, that both the unpleasantness of quinine and the pleasantness of sugar are inherently determined psychological properties; that is, they emerge in a situation which involves a functioning organism and particular chemical substances (sources of energy). These affective properties accordingly belong just as much to chemistry as they do to psychology. It is as impossible to find a final answer to *why* a thing is pleasant to man as it is to know *why* one particular coal-tar compound possesses certain properties which are different from those of all other coal-tar compounds. The one may be gorgeously colored; the other may be a dingy brown or black. But it is also possible, as far as the affective properties are concerned, to show within limits how they emerge, or change, or disappear under particular conditions (1) of heredity (different species), (2) of personal history (training, health, previous satisfaction), and (3) of environment (duration, intensity, chemical and physical nature of stimulus). The understanding student does not expect science to give final answers to any question. Science rather attempts to give relative knowledge. It seeks to reveal how one thing changes with another. It attempts to deal with concomitant variations. It strives to show dependence. It largely ignores the *absolute*.

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OUTLINE

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CHAPTER XVII

LEARNING

A. *Introduction*

We have surveyed man in terms of his several unlike functional properties. We have found him to be a dynamic organism — one which is continuously functioning in some manner during every moment. Life does not come and go as the tide ebbs and flows; it continues; and such continuity implies unbroken functioning. The level may shift from hour to hour, it is true, but never, except at death, does it drop to zero. Life, as exemplified in each *individual*, moves steadily onward; and during its course becomes greatly affected by various unlike causal agents. Some of these changes are physiological and anatomical; and some are definitely psychological. Among the latter, we may list those which are learned. We must now inquire concerning the particular place of learning in the functional picture of man. We have finished our specific treatment of the various modes of psychological activities; but at no place have we listed learning among them. We have not done so because learning is not a specific way in which the organism functions. Man functions, for instance, by way of perceiving; but he does not function by way of learning. Woodworth, for example, remarks that learning is no one particular kind of activity. Any activity can be called learning, in so far as it develops the individual and makes his later behavior and experience different from what they would otherwise be.

We have briefly touched at various times upon this general problem in our discussion of man's functional properties. Man's functions differ widely. Since learning is one phase of functioning, its nature necessarily differs widely. There is, strictly speaking, no one form of learning unless "functional change" can be made to cover all cases. We say that man discovers some new characteristic of the objects of the world through perceiving, or understanding, or reasoning. Something different emerges. We

may say that he has then learned. The little baby, for instance, shortly discovers that satisfaction is to be derived from its bottle. The emergence of this new source is learning. A major difference between animal and human being concerns the several *modes* of discovery. The former is largely limited to perceptual observation of object-properties; the latter is not. Learning refers to the acquisition of the new, such as a vocabulary, skill, knowledge, standards, and goals. The speaking of words and the moving of hands (skill) are essentially alike; knowledge, standards, and goals refer to types and kinds of meaningful properties of objects and situations. We also find that learning refers to addition of the new to the old, the substitution of one thing for another, the elimination of ineffective or irrelevant or undesirable objects, and the knitting together of effective and desirable items into a single meaningful whole. We also find that learning implies improvement where man's functional products are considered in the light of a set standard. Thus we commonly say there are fewer errors in typing or that writing is more legible. Men again refer to increased efficiency whereby less time and less effort are required to resolve a situation or to carry out a task or to reach a goal. The student should understand that each of these really represents a way of looking at functional products. The amount of time and the number of errors, for example, are not psychological functions; but they refer to what is done within a given situation.

B. *Some Problems Touching upon Its Nature*

a. A Matter of Functional Product. Learning, generally speaking, refers to a change in functional product. The product may be perceptual, actional, emotional, etc. It implies a difference in what is done in a particular situation when such is viewed earlier and later. Man functions psychologically in one way at one time and in another way at another time. The difference in performance between the two situations, if no non-psychological factor (disease, drug, maturation, injury, decline) is introduced, is ascribed to learning. The boxer no longer closes his eyes at the sight of the approaching glove and the hunter ceases to flinch when he pulls the trigger. Each has changed — learned. In *other* situations, however, each may continue to exhibit these normal products. They have not been lost. In every case, we must assume that there is a definite set of causal factors which produce a definite output; that

some change occurs among these determining conditions; that there is an accompanying change in the nature of the functional product; and that a new set of causal conditions may then exist under which there will be continued functioning until some new change again enters. The young baby, for instance, directly observes the unpleasantness of medicine and spews it out. The parent may then hold its nose, thereby introducing a new causal agent, and the baby swallows. Its behavior has accordingly been modified. The unpleasantness is in no way destroyed; but the desired end is accomplished. Instead of employing this method, the parent may possibly offer candy or a toy in order to reach the same end. Goltz, for example, could not get his dogs whose brains had been impaired to swallow meat which had been sprinkled with quinine. But he could order his normal dogs to eat such treated meat, and they would do so. The latter were thus capable of being functionally changed with respect to a particular object.

b. Psychological and Physiological Changes. Learning, descriptively speaking, proceeds at a meaningful level. It necessarily involves the direct observation of objects and situations. There can be no learning in the absence of a consideration of the properties of things. In every moment of perceiving, remembering, or thinking man deals directly with meaningful things. If learning is merely one aspect of the psychological functions, it cannot drop below observation, *except in terms of causation*. We do not imply, however, that changes do not occur at a submeaningful level; they unquestionably do. Man's physiological functions frequently change — he may, for instance, begin to produce unusually large or small quantities of bile. But such modifications are physiological or chemical. They must be approached by non-psychological methods. They involve different concepts. We accordingly differentiate here between (1) exercise whereby a muscle is enlarged, hardened, and strengthened and (2) learning. We also consider adaptation (changes in end-organs) as being a physiological phenomenon. Furthermore, various changes in threshold (raising or lowering) possibly induced through the application of some drug are not psychological. Such changes may, of course, serve as causative agents which greatly affect the various psychological functions. As such, they have a place in psychological *explanations*.

c. Learning Concerns Properties — Not Consciousness. We do not wish to raise the question of consciousness; we are concerned solely with determinable and describable changes which occur in the activities of organisms in situations. We deal not with mind, but with functional products. We do not ask if rats observe sensations. We unquestionably assume that animals as well as human beings perceive certain objects in terms of certain properties and, if functionally capable, change their modes of performing with respect to them. We accordingly hold that the animal learns as a direct result of observation just as man does. If animals cannot or are not allowed to observe they cannot learn. For instance, the dog which has been deprived of its cortex is seemingly reduced to a semi-vegetative level. We do not imply, however, that species which lack a cortex similar to that of man do not learn. All animals are seemingly able to change. The fish, with its rather simple brain, can be modified in various ways. Pikes which normally feed upon minnows may leave them alone within a *particular* situation if they are sufficiently punished by striking a protective glass plate each time they dart at a minnow. The glass plate can finally be removed without too great danger to the minnows. The pike, we assume, continues to *perceive* them; but it perceives them differently under these conditions. The young child which earlier reached toward the flame comes shortly to keep its hands away from it. Here, we know, the object has a new property. It is no longer merely the bright object; it is an object which hurts. We need not speculate; the child itself reports this fact. The emergence of this new characteristic of the flame is marked by a definite change in behavior. Until it does emerge, the child may cry lustily; but it will again put its hand upon the flame. We assume that neither animal nor child necessarily remembers or infers or reasons in such cases. It is really a matter of direct observation. Moreover, we do not find the least justification for assuming that the animal and little child always learn in one way and that the adult always learns in another way. We must hold to a strict continuity in some form from the first day of an individual's life onward through the years. New ways of functioning (learning) unquestionably appear. But in every case, there is some object observed in terms of its properties. Little children do not suddenly begin to observe on their first anniversary. Nor do they observe stimuli, when the highly trained physicist or chemist cannot do so.

d. The Place of Observation. The writer, for example, recently changed from the use of a light gun to one of heavier caliber. This pistol jumps badly. He accordingly had to learn the proper manner of handling it. This involved shooting and observing the manner in which it was held; then changing the tightness of his grip and again shooting it. By close observation to such matters, a fair degree of accuracy was shortly attained. Ordinary games of skill similarly show the significance of observation. Efficiency instantly lags when an individual shifts from observing the game to observing an object (sweetheart) on the side-lines. In the same way, action patterns may instantly change under emotional situations in which one observes, or attempts to observe, those things while lie apart from the particular task. No situational pattern ever becomes so automatized that observation is no longer necessary. The most expert golfer, for instance, may strongly protest against the unnecessary intrusion of any distracting object. Any talking or movement while he is driving may arouse his ire. Such a causal agent as a spectator's cough may considerably change the nature of his stroke.

e. Learning as a Modification of Native Patterns. By regarding learning as describing or referring to the various changes which occur under a shift in the causal agents which are always concerned in every bit of behavior, we are able to look critically at the statement that learning is simply a modification of native patterns or functions. Our understanding of the acquired would be greatly aided by actually knowing *what is native*. With such knowledge, we could readily proceed to sift out all learning. We could specifically state the exact amount of unlearned and learned behavior in each particular situation. Although we fully recognize that native factors must necessarily determine in part every major activity of man, we are unable to point out any dividing line. The acquired, functionally speaking, is not spread on as paint may be applied to a man's face. It is more comparable, to cite an analogy, to the change which occurs in the speed of a ball as it rolls downhill. A certain amount of the change which occurs as the ball proceeds is due to the fact that it has been rolling — we say that it gradually gathers momentum. Until science actually develops reliable methods for laying bare the so-called raw materials of life, we shall find little use for any conception of the purely native.

Is salivation at the sight of food, to cite an illustration, native or learned? Is the withdrawal in fear from a pet dog, that after many years suddenly turns upon one, a native or learned matter? Ponies which had never eaten flesh did so when they reached the Antarctic. Was the pattern which appeared here learned, or was it a wholly native response under such particular causal conditions? The "response" of eating was like that in many other previous situations, but the object eaten was very different. In the ordinary conditioned reflex experiment, as we shall shortly show, some product such as saliva repeatedly appears but in response to the different situational objects which may be seen or heard or felt. Learning here describes the emergence of the same functional output under a shift in the various objects which compose a total situation having to do with the satisfaction of eating. We suggest that it is better to regard the particular changes which occur in every case as being the only possible phenomena which could occur under the conditions. Our task then concerns the exact enumeration and description of such causal factors for purposes of understanding and control. We may discover, perhaps, that any object can be responded to in a variety of ways. For instance, food may be eaten, hidden, preserved, carried openly or secretly to a friend, or sold to a stranger. Moreover, any one of these modes may become *specific*, that is, others may not even appear or they may drop away. What is done depends upon each particular situation; the response, in every case, rests partly upon the meaningful characteristics of the observed objects. And such are dependent upon the functioning organism.

f. Extension and Reduction. Functional changes occur by way of an enlargement or extension of meaning. The little child which is afraid of no object until hurt may come finally to run in fear from many things. Psychologically speaking, situations actually grow and enlarge. That which formerly had no emotional effect may later call forth anger or love; that which was seen in terms of its class properties (e.g., a house or a horse) may be observed minutely in terms of strength, size, shape, color, length, and movement; that which once was wholly disregarded may demand months of hard labor spent in reasoning. Simply to discover a problem in a particular situation may result in great functional changes. Functional development consists in part in the emergence of meaningful characteristics of effective situations or in

the dominance of some one characteristic. A situation may accordingly expand with no change either in action pattern or in the form of satisfaction itself (one may come to love many individuals); or a situation may gradually shrink to include one particular object which brings satisfaction. A great deal of learning comes about in each of these ways. Whenever an individual discovers new sources of satisfying old desires, the first way holds; and whenever he deals with only one and disregards various other similarly satisfactory objects, we have the second way. This is selective activity. It holds for all age levels.

g. **Animal Learning.** Some forms of learning can be carefully studied through the experimental use of subhuman forms; they can be directly manipulated in many ways quite impossible with human beings. Various incentives, such as hunger, thirst, punishment by shock, and sex can be employed with them more readily than with man. Moreover, the contributions of the brain as well as other bodily structures as causal agents of the psychological functions can be studied by means of constant stimulation over long periods, by the use of drugs, and by surgical technique. Considerable information upon learning has accordingly been derived from studies involving partial or complete destruction of the cortex both before and after the establishment of a functional pattern. The studies of Lashley have been very illuminating in this connection. Various effects resulting from changes in the environmental conditions have been studied with animals. They have been permitted to establish a source of satisfaction within a situation (maze). Definite and controllable changes have then been introduced and the resulting changes in functional product noted. Such matters as persistence, variability, emotional stability, mode of attack, and comparative success have, among many others, been examined. The value in each case, as far as an understanding of human beings is concerned, is necessarily limited. That is to say, the number of trials required by a dog to discover the correct path to food may have no direct significance for man. Such justification, however, is not necessary. The study of animals themselves is highly instructive. Moreover, out of such studies come the comparative materials necessary for the establishment of a graded series of animal levels. Finally, by applying the method of analogy, it is possible to hold, in so far as man and animal are alike and the same causal factors operate similarly in

each, that what is true of the animal will be true of man. A method which has been widely used in the study of the animal's functioning is the conditioned reflex.

C. *Conditioned Reflex*

a. Definition. Most individuals know, of course, that at times when they are hungry and they happen to remember, imagine, hear, smell, or feel food, their mouths will "water." The small-town joker knows the salivary consequences to the cornet player by standing in his view and chewing industriously on a lemon. Although the saliva is always flowing, most individuals know that when they place food in their mouths, the flow suddenly increases. A lemon, for instance, may cause a copious flow. Now, which of these is the natural flow — that under sight and smell and imagination or that when food is placed in the mouth? If we call the flow to food a natural reflex, then the flow under the former conditions is a conditioned reflex. A conditioned reflex, therefore, is commonly regarded as being a definite case of learning in which a "natural" response (salivation) which is made to a particular kind of object is also made to some other object within the situation (Fig. 96). In each case something, we assume, is definitely observed. Pavlov, a physiologist who did pioneer work in this connection, has given confirmatory evidence here. No conditioning, he said, can possibly occur in an animal from which the brain has been removed, or which is asleep, or which is not motivated or which is not strongly stimulated.[1] All this implies that there must be observation and discrimination (or selective reduction) within the total situation. A particular thing must be responded to, and it is an object — not physical and chemical energy.

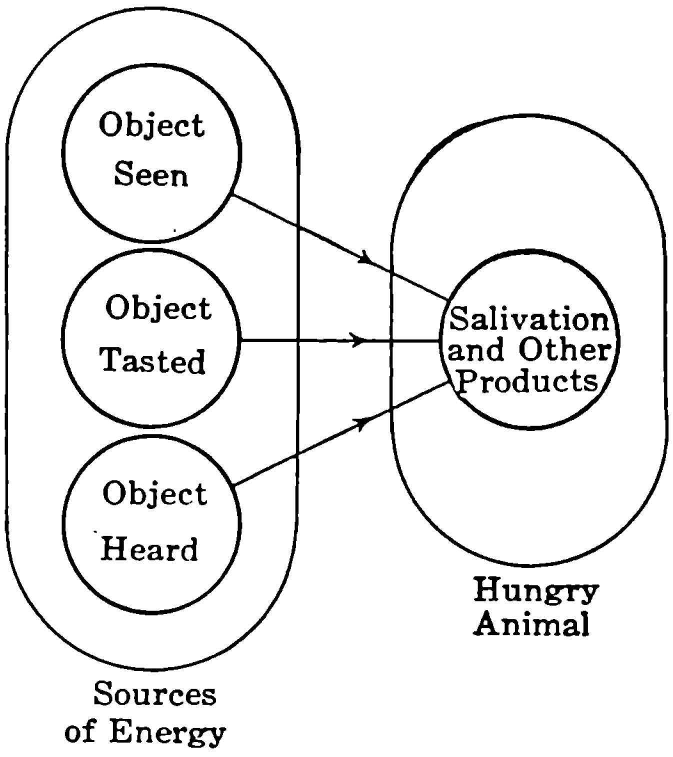

FIG. 96. Many objects may effectively cause salivation.

[1] Recent studies indicate that one form of conditioning may occur in a decorticate dog under auditory and visual stimulation. See Culler, E., and Mettler, F., "Conditioned Behavior in a Decorticate Dog." *Jour. Comp. Psychol.*, *18*.

b. Method and Conditions. Conditioning, as in the case of a dog, demands that the animal be placed in a situation over which rigid control can be exercised. There may be various objects in the environment of the animal of a visual, olfactory, tactual, and auditory nature. The animal must furnish one necessary condition — it must be specifically motivated, else it will go to sleep or observe some object other than the experimental one. When sufficiently shocked, it must pull its foot away; or it must be hungry enough to salivate. A dog, for instance, may be arranged in a closely restraining harness with his left front foot upon an electric plate. Above his head there hangs a sound source. The stimulus is given for a short time (several seconds) and then immediately following it, a weak electric current is passed through the grill, thereby shocking the dog. It generally responds at first by howling, tugging, swaying, jumping, squatting, panting, and lifting all *four* feet. Under constant conditions (sound and shock), most animals very quickly drop much of the total bodily pattern and retain the foot lifting; some never get over the whole pattern. Under learning, then, the situation definitely changes; whenever the sound comes, the foot is lifted. The dog does not wait for the shock.

c. Selective Observation and Response. Here, we say, is a total situation — a set of causative factors — in which one particular property becomes isolated. We do not suggest that the others must necessarily drop away. But they are held constant. One object stands out and determines action. If any observable change occurs — if old objects are removed or if new objects (visual, auditory, etc.) are introduced, the established pattern frequently drops out. The situation is different; the animal observes other things. Speaking loosely, we say it is distracted or that the situation is strange. Furthermore, as Pavlov points out, almost any object of the same general character may release the conditioned response. If a stimulus of 500 cycles has been regularly used and then other wave lengths (1000, 1500, or 2000) are given, the dog may also respond. If all such physical agents are not followed by shock, but the one stimulus of 500 cycles is, then perceptual selection tends to continue until the animal responds only to the one sound property. Thus out of gross, massive action patterns which obviously involve the whole organism, finally issue these specialized patterns. But it must not be understood that only the lifting of the foot remains. Breathing, posture, and slight movements may tem-

porarily drop away when the sound appears. These functional changes in the dog are grossly similar to the functional shifts in the child whereby the early mass patterns come finally to show specialization and isolation. The changes in the child are, in no sense, reflexive.

d. Is All Learning of This Type? Some students hold that all learning, either animal or human, child or adult, is of the sort represented by salivation at hearing a particular object which has occurred in a satisfying situation. Learning may possibly be called "conditioning." But it is impossible, nevertheless, to fit under the conditioned reflex the vast amount of learning which occurs in those situations in which we perceive objects for a single time, as when one reads a line of poetry which can then be *written, recited, typed,* or *recognized;* or in those situations in which we understand and directly grasp a point which may then be used on many occasions; or in those situations in which during a period of months we laboriously think out the solution to a problem and thereby learn something entirely new. Moreover, if we were able to discover in the large number of ordinary cases of perceptual learning as well as in those involving thinking, some simple bodily basis (either structural or functional), with which to start and upon which to build the conditioned reflex, our understanding of learning as conditioned reflexes would be greatly aided. In this connection, Franz writes that the conditioned reflex may materially aid us in understanding how modes of reactions change "but except for the simplest physiological activities, it is an unsatisfactory interpretation, and the concept must be greatly stretched to explain even the simplest forms of learning by man." [1]

We must also recognize that the ordinary conditioned reflex may be fairly fragile. After hundreds of repetitions, it may drop out in an astonishingly short time, unless repeatedly reënforced by food or shock. After a few presentations of the conditioned object when unaccompanied by reward or punishment, the animal no longer responds as it earlier did. It begins to struggle in the harness, or it falls asleep. As evidence of the rate of elimination, we point out that within a period of 15 minutes, the amount of saliva produced declined from 13 drops to 0 drops (Pavlov's dog).

We must contrast such apparent fragility with the durability of many other patterns established under other conditions. The

[1] "Neurology of Learning." Chapter in *Comparative Psychology.*

writer has seen fine dogs ruined as far as good hunting is concerned by being accidentally shot (once) while performing in the field. A hysterical woman may possibly chance to observe during a clinical test that her leg moves when her knee is tapped with a hammer by a particular individual. Thereafter, whenever that particular individual with or without a hammer, or possibly another individual with a hammer, approaches her, her leg begins to kick out! She may start either when the clinician is far away or when near — her behavior apparently depends upon her understanding that he is coming to *her*. But this psychoneurotic pattern emerges too quickly to be a conditioned reflex. Moreover, it persists too long and involves other conditions, such as understanding. Consider two other illustrations. The writer has broken dogs of sucking eggs by placing a raw egg containing cayenne pepper in their mouths and then holding their jaws tightly closed upon it. One time will usually "break" them. But, we must note that they later do *not* run from eggs, nor struggle, nor salivate, nor shrink. They will continue to move freely about eggs, and they will look at nests containing eggs without flinching or struggling. But *they no longer take the eggs into their mouths*. From the struggling, pawing, salivating dog with the peppered egg in his mouth, there now issues a non-struggling, non-pawing, non-salivating dog which refuses to suck eggs. The young puppy if permitted may bite a toad, thereby getting the acid secretion from the toad's warts in its mouth. As a result, the puppy will salivate copiously, shake its head, run around, and paw at its mouth. Usually one attack is enough for the puppy, *unless it is urged* by its master. It will chase toads, snap and bark at them, paw and roll them; but it will not bite them. Its behavior patterns strongly resemble those of play. Considered in terms of sheer variety, as well as the persistent refusal to bite, such behavior patterns are difficult to fit into the usual dimensions of the conditioned reflex.

D. *Habit*

Some individuals regard learning as consisting largely or wholly in the formation of habits. Many seemingly regard habit as being an actual force or causative agent. As we have said, habit must be regarded as being a descriptive term. It refers to the fact that something is regularly done — certain psychological products appear — in certain situations. In this sense, habit itself cannot

do anything. It does not, for instance, weld elements of behavior together nor does it *cause* an individual to act. The fact that certain desires and certain action patterns repeatedly appear under particular conditions is the habit. A person may possibly talk quite normally in one situation (with his associates), but stutter badly in another situation (with his superiors). It adds nothing to our understanding of his inadequacy to say that he acts in this latter way because of habit. Franz, for example, points out in connection with aphasia that the nature of particular situations makes for loss or difficulty of action and vocalization. The aphasic may accordingly be able to give the names of objects swiftly to his instructor; but the presence of a stranger in the room may make him speechless. It is evident, Franz notes, that a stimulus does not result in a simple chain of neurone activities such as is commonly supposed in a habit. It does not produce a simple nervous impulse which passes to the cortex and out to produce speech. "Nor does any other stimulus, simple or complex, bring about responses in such a simple fashion."[1] It is difficult to understand the mechanism whereby an individual would establish a habit of stuttering when talking with one person and another habit of speaking properly when talking with another individual. We must assume very specific causation in each case. But such disturbances are more subtle and deep-seated than are patterns gradually built up through repetition. Moreover, as we have previously indicated, animals as low as the rat may suddenly shift to entirely *new* action patterns and thereby continue on to a source of food. The habituated side, in these animal cases, actually concerns the situation as a source of satisfaction.

There are, furthermore, some who regard psychological diseases as being forms of habits. From this angle, disease becomes a form of learned reaction. We must recognize, however, that whatever the rôle which habits may play in such diseases, they must always be sensibly regarded as being *symptoms* or indications — not causes. If it is easy for an animal to shift from a long-practiced pattern (as in case of Lashley's rats), it would seem possible to change the specific habits which disturb a human individual. By punishment or reward, or by substituting new sources of satisfaction, undesirable habits might either be weakened or completely removed. We must, however, await an adequate description of

[1] *Op. cit.*, p. 239.

psychological diseases in terms of particular simple habits before we can properly evaluate them as causal factors. As yet, no one has ever reduced such cases to this level. Even the hysterical woman who kicks either leg when approached by a clinician does not seem to be doing it as a result of an established habit. It seemingly comes at once without training (unless seeing her leg kick out one time is training) and it may disappear just as suddenly as it appears. This sort of behavior, we hold, is quite similar to that of cows which deprived of sufficient phosphorus and given an opportunity will immediately eat bones without ever having previously eaten them. As soon as such animals receive sufficient phosphorus in their other food, they immediately disregard the bones. One can adequately describe the particular causal conditions under which bones are eaten. Proper treatment to remedy such behavior may be followed. But such treatment in no way aims at breaking a bone-eating habit. Moreover, occasionally upon leaving a room during the day, an individual may turn on the light. Although this may happen only once or twice a year and even though it involves turning on the light when leaving, yet many persons glibly call it a habit.

E. *Some Factors in Learning*

a. Age. The adage that "you can't teach an old dog new tricks" finds little experimental confirmation unless advanced old age is considered. The adult of forty is unquestionably able to learn as well as the youth of sixteen (see Fig. 97 from Thorndike). Evidence indicates that there is an increase in learning ability up to the age of twenty and that little change thereafter occurs for many years. Carr, for example, has pointed out that grade children are seemingly as good at maze learning as graduate students, although the methods which they use are somewhat different. The child is neither as cautious nor as critical as the adult. Under similar conditions, both require about the same number of trials. Data also indicate that the adult on the whole changes more readily in learning nonsense materials, numerals, and prose materials. Evidence of the age factor at the animal level is meager; but Stone,

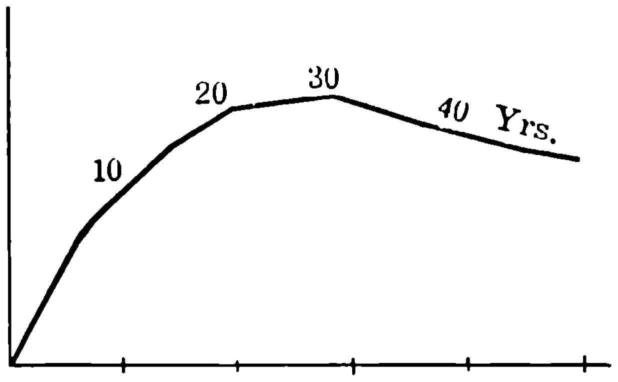

FIG. 97. What effect does increased age have upon learning?

for instance, has reported that rats reach their maximum learning level around the age of one month and do not change significantly for two years, which is equivalent to two-thirds of their life span. A major cause of the adult's failure to learn as readily as might legitimately be expected in terms of his *vast amount of previous learning and past experiences* is seemingly due to his motivation.[1] The child and youth are driven to do well; their elders expect them to improve. But the average adult often assumes that he has definitely arrived. He is either indifferent or antagonistic to serious attempts to continue his improvement. He knows enough for his own purposes; at least he is sufficiently satisfied that he does nothing about his ignorance. He finds no need for further striving. It is not strange, therefore, that he does no better.

b. Heredity. The rate and amount of functional change in learning depends *within limits* upon the intelligence of the individual. The feeble-minded are, in general, slow to change; the superior change easily. But a few feeble-minded are specially gifted — some in music and some in mathematics. Among the musically endowed are to be found those who can seemingly play selections after having heard them but once or twice. Yet we know of no case where such individuals have ever produced a single piece of original work; they can "mimic" but they cannot create. The mathematically inclined may recite lists of digits after short readings or give answers to complex problems in multiplication and division. In this general connection, evidence also indicates that there is little relationship between individual scores on *intelligence* tests and scores on maze learning. Some animals and normal children are not inferior to normal adults in such tasks. Heredity apparently sets physiological limits to one's functional capacities. Man's abilities are thus circumscribed. The feeble-minded are generally unable to perceive, or imagine or think as much as normal individuals. Some men can never go far because nature has established her barriers; but others have an open road ahead. Most men probably never approach their limits, although students have referred the plateau to be found in certain learning curves to

[1] Some men maintain that the more one has learned, the more *easily* he should learn. If learning really had such a cumulative effect, the individual of forty should greatly outstrip the youth of sixteen. Interestingly enough, however, he does not do so.

such causal conditions — an assumption about which we raise doubt. Again, if we hold a normally functioning brain to be a hereditary endowment and a necessary causal factor in learning, we can understand the obvious differences in the performances of normal and cortically disturbed animals. Figure 98 shows learning curves for normal rats (A), those with one-third of cortical areas gone (B), and those with two-thirds of such materials missing (C). The last group seemingly learn very slowly, that is, they require many trials and make many errors in comparison with the others (Lashley).

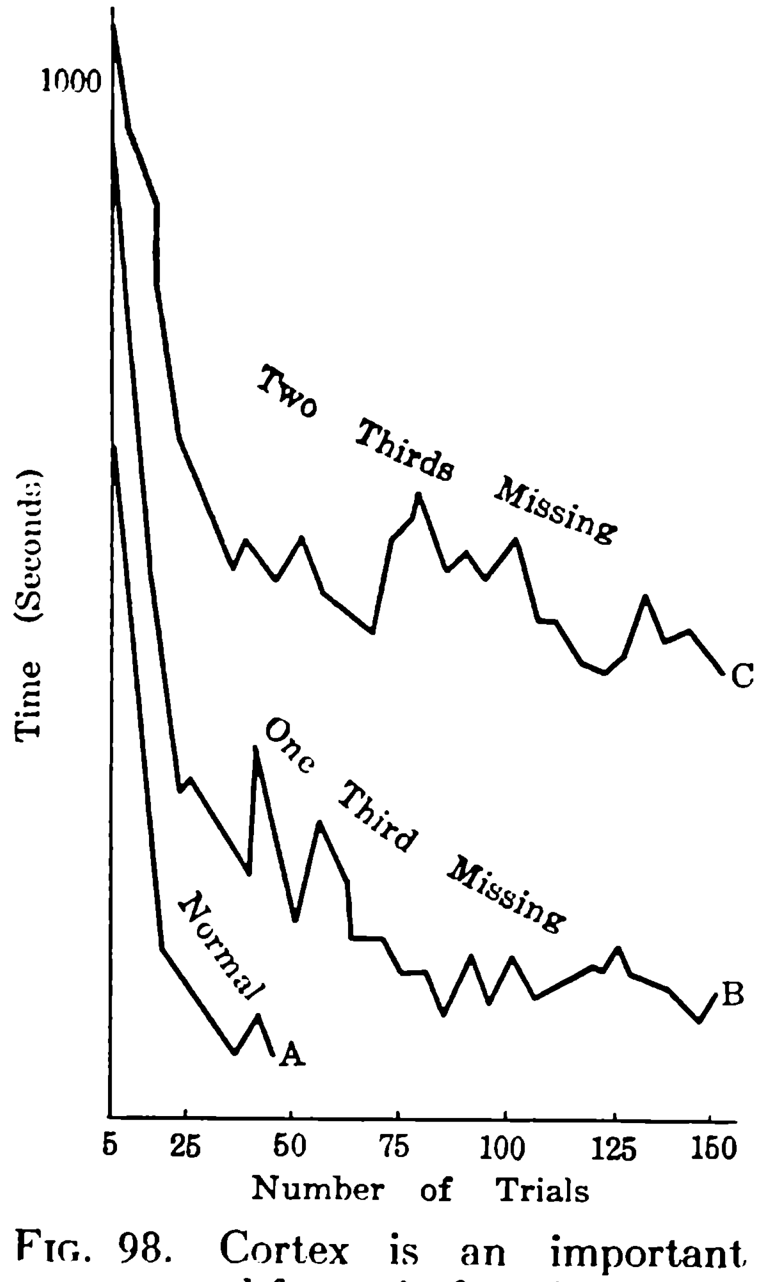

FIG. 98. Cortex is an important causal factor in function.

c. Understanding and Meaning. In studies of learning, as in all experimentation, an attempt is made to control or to hold as constant as possible all significant factors concerned. Among such major conditions is that of meaning — it enters at every moment. Certain psychologists may possibly ignore the problem of meaning in many other situations. But in studies of learning full recognition is always accorded it. No comparable basis is assumed to exist, for instance, if certain materials to be learned are more familiar to one subject than to another. In order to equalize familiarity and other possible meanings, common usage is made of nonsense materials. A nonsense syllable is usually composed of two consonants and one vowel, as in *zom* and *fex*. These are not class names of environmental objects. *Zom* is a word which may be equally unfamiliar to all who have had no training in learning nonsense materials. The use of such syllables tends, moreover, to reduce any affective or emotional properties which might possibly characterize familiar objects. The employment of such materials generally increases the relative difficulty of learning as measured in terms of trials and of the time spent. That is, they are more

difficult than poetry, prose, or digits. Figure 99 reveals the varying amounts of time required to learn the same number of items (words, syllables, numbers) of poetry, prose, digits, and nonsense syllables. Here is a quantitative comparison of various learning times. These data, we suggest, are significant. They clearly indicate that there is no one type of learning; not even the same individual learns all things in some one way. The rate of learning is definitely dependent upon the materials to be learned. The organism does not grind all its grist in the same way. There is, in short, a different rate for *each* learning situation. Meaning unquestionably plays a part in the integration of materials. Prose and poetry tend readily to fall into integrated patterns. Each unit (pattern) is apparently learned more easily because of its common meanings. When some common meaning is introduced through *understanding* into a body of material, it facilitates both the rate of learning and the degree of retention. Failure to understand is often a major cause of failure to learn. To see into something is a major contributory factor to achievement, and it may definitely delay forgetting.

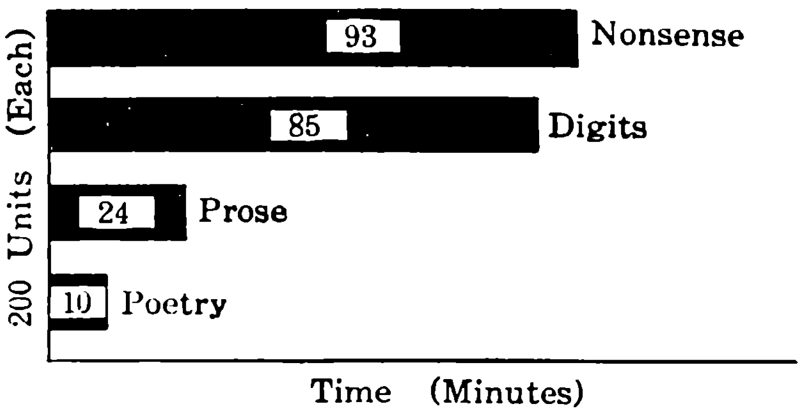

FIG. 99. The nature of the task (material) determines the nature of functional change.

d. Intention and Purpose. Among the various conditions affecting learning is that of intention, which is a meaningful characteristic of a situation. Man commonly does not learn merely for the sake of learning. He usually strives for definite results; he seeks some particular outcome. His psychological functions are directive with respect to objects. He directly concerns himself with objects in order to secure satisfaction. Individuals observe many things in particular situations which carry no forward-reaching meaning. They may walk down the street, avoiding others; they may stop at a crossing in order to discover if the way is clear. As they proceed, they may observe that there are houses along the way. But in each case there may be no recall of many phases of the possibly observable situations. They may *report* later upon the crowded condition of the sidewalks, upon the presence of vehicles in the street, and upon the many houses which they passed. But they fail to report upon other things. If

occupied with a *thoughtful* situation quite foreign to the *perceptual* situation, they may be able to report surprisingly little. Recently an instructor during an afternoon ride crossed and recrossed a river on a bridge about one-half mile long, yet a chance remark that evening revealed that he knew nothing about having passed over a river. Many individuals who have necessarily traveled some street many hundreds of times can report very little concerning the number, shape, size, color, and arrangement of houses. There are records of individuals who have read passages, as in a ritual, many thousands of times but who have not learned them. They did not, because there was no need to do so. Experimental studies have been arranged in which a series of syllables are to be learned in *pairs*, for example, *zog* (*a*) is given with *yim* (*b*), *rov* (*c*) is given with *bex* (*d*). The results reveal that the chances are ten times greater that *b* will later be reported with *a*, than that *c* will be reported with *b*. The subjects did not intend to learn them in the order of *a* and *b*, and *b* and *c*. The significance of intention is made quite clear in such experimental cases.

1. *Incidental vs. Intentional Learning.* Some students raise a distinction between incidental and intentional learning. Such a distinction adds little to our understanding, especially when "incidental" refers to what one might be expected to learn. Should we expect the individuals of our (previous) illustration to observe the various individuals on the sidewalk, or the kinds of cars on the street, or the many houses along the way, even though they were hurrying to work or planning the details of their vacation? Regarded in terms of causation, nothing in an observed situation is "beside the point." An object, such as a man, may have many possibly observable characteristics. But those particular features which are not observed, as a result of the very nature of the particular situation, cannot very well be regarded as being incidental. Particular properties must necessarily emerge under certain causal conditions; other properties cannot emerge. That is, they cannot be described a moment after the period of observation.

2. *An Experimental Illustration.* In an experimental situation a large number of observers were asked to determine as rapidly as possible the number of times a particular letter occurred in a group of other letters. All the letters were arranged six in a row and there were several rows. As soon as they had finished, the subjects were asked to report directly upon the various *other* letters which really

formed the background for the particular letter. They reported an average of one other letter. Moreover, some subjects could describe neither the colors of the letters nor the paper on which they were printed. The laboratory thus gives precise quantitative expression to a universally recognized truth. Man is caused to observe certain things (so much) at any time. That which emerges — which he observes — depends in part upon the functioning individual and in part upon the nature of the energy source. If there is no cause on either side for some characteristic to be dominant, it will not be observed. Nothing, for example, is to be gained by saying that the color of an object is observed if it makes no change in the functions of the observing individual.

3. *The Significance of Particular Situations.* Man commonly observes and learns about objects when they fit into particular situations; when they stand out or become dominant. When a particular situation demands that he learn in order to secure satisfaction (either now or later), he observes differently. If he is contracting to wash the windows of a house, he can report upon their number and size. If he is blind and depends upon his cane to guide him along a familiar residential street, he can usually state the exact number of sidewalks (to houses) in each block — something which the average normal-sighted individual cannot possibly do. It is evident, therefore, that the situational demands are very different in these two individuals. It is accordingly impossible to drop a definite intentional meaning from many situations without destroying the forward reaching effects. Every one doubtlessly knows that a man may actually remove his watch, look at it, and return it, yet be wholly unable a moment later to report the time to another. Yet he momentarily learned the time in terms of his own particular situation. Finally, we note, that experimental studies have shown that the specific intention generally has more influence upon what is called remote recall than upon immediate recall. The changes tend to persist longer. Simply knowing that they will be held later for certain materials, other things equal, definitely tends to cause individuals to learn more effectively. Their observation is directive; the situation extends toward the future.

4. *Situational Control.* The situation, as we regard it, does not need to be *verbalized.* The child observes situations and learns about objects in them. Desiring the satisfaction of eating, it

shortly learns to work the catch on the pantry; wishing to participate in group activities, it rapidly masters the rules of the game; or wanting to avoid punishment it may soon learn to lie. In hundreds of cases, there is no intention of learning because of future needs — there is only the desired end to be achieved in this particular situation. The end may be merely the observation of something which is interesting and meaningful because of the inherent constitution of the individual. Any subsequent report upon the thing may be a by-product. One may walk down the street to pause suddenly overwhelmed by the sight of a mangled child lying under a car. Asked later, he may know nothing about the color of the car or the piece of newspaper lying on the street. In short, who cares about such possible things at such critical moments? They do not fit into the meaningful situation. Yet the individual may be able to report upon various other details which were significant because of the very nature of the situation. And he may drive more carefully in the future lest he himself be similarly guilty. The functional effects of some situation upon a young child may be quite like that in the case of the animal which, upon being placed in a maze with a food source at the end, very quickly changes its performance under the satisfaction of eating. In all such cases, the particular situation becomes possessed of a particular characteristic. It is well known that animals which have been used for a time in experimental work and have been fed under these conditions seemingly strive to get to the situation. Liddell, for instance, reports that his experimental animals would pull strongly ahead on leash as he walked with them toward the laboratory! We must assume that such behavior was definitely directed toward the satisfaction to be derived in that situation.

e. Affective Properties. Man commonly deals with things in terms of the nature and degree of their satisfaction. Much of his learning, as we have said, arises directly or indirectly through the discovery (and the perpetuation) of such sources. From his very early days, man begins to learn that certain things are unpleasant and that other things are pleasant. Through observation, objects come to possess new characteristics to which individuals respond by seeking or by avoiding actions. Like all psychological products, the affective properties of an object depend upon the relation sustained between an organism and a particular energy source. They are not physical and chemical properties; yet they definitely

characterize certain objects and substances. Pleasantness or unpleasantness is not an independent thing or process which man plasters upon or injects into or associates with objects. Man does not start with a certain amount of pleasantness (unpleasantness) on the one hand and an object on the other hand and then proceed to mix the two. Regardless of how rapidly or slowly they emerge, these properties are inseparable phases of observed situations. It is not surprising that a property, such as color, should serve as an immediate determiner of an action. An individual may be looking for a *blue* object and so reject all *red* or *green* things. Such observed properties are meaningful characteristics of things which determine behavior. And so are the affective properties, although some students seem to hold that pleasantness and unpleasantness can do nothing.

Energy, we assume, directly affects an individual and as a direct result he may observe an unpleasant object. When man has discovered that an object is unpleasant, he may possibly avoid it in the future. We do not assume that an organism has to *remember* definite things from previous experiments in order to react to the color or the unpleasantness. Man acts selectively and discriminatively to observed objects in terms of their various psychological properties because there is nothing else to which he can react. That is, he cannot possibly react psychologically to stimuli — as forms of energy. Moreover, we have no reason to assume that animals possess some strange power of observing physical and chemical energy, if man himself cannot do so. We accordingly suggest that the pleasantness and unpleasantness of particular objects may determine learning; that is, individuals may change with respect to objects when such properties emerge. A little of each may produce slight changes; more, may produce greater changes. In this connection, Thorndike remarks that, in ordinary life, mental connections are under a powerful and persuasive control from their after-effects. Satisfactory after-effects tend to cause continuance of a connection if the situation continues. Annoying after-effects often cause the subject to change to a different connection. If the situation continues, there is progress toward a status of satisfaction and stability when it is reached.[1]

f. Punishment and Reward. Problems of punishment and reward mainly concern the affective characteristics. The intro-

[1] *Amer. Jour. Psychol.*, *46*, p. 427.

duction of punishment (shock) into a learning situation (maze) as a penalty for taking too much time or making too many errors may be followed by a significant decrease in the number of trials and errors and the amount of time. The situation becomes more meaningful; and the individual becomes more observant and cautious. He increases his desire and determination to get through with it as soon as possible. The unpleasantness becomes one of the major determining features of the situation. It may be as important here as the pleasantness of eating is in the case of the rat in a maze situation. Moreover, knowledge of the nature of his performance may contribute to the pleasantness or unpleasantness of a task and so influence man's learning. The unpleasantness which commonly arises when one is told that he is not doing as well as he should may result in more errors and longer time. He may become less cautious, he may work more rapidly, he may try out various methods and he may become indifferent (or antagonistic). Encouragement and praise, which are forms of reward (pleasantness), often serve to sustain an individual; he does not become indifferent and unobservant. An understanding of the progress of learning — that is, increased satisfaction — may serve as a reward. The data of an experiment in which three groups — one with full knowledge of progress, another with some knowledge, and a third group with no information concerning progress — worked upon a common problem indicate that the first group made the greatest gain.

g. Recitation. A major value of the recitation of material during learning lies in the knowledge that it gives of progress. The individual thereby understands that he is moving along; that he is approaching his goal. The pleasantness attendant upon knowledge of achieving may actually spur him on, just as observing a place of protection and safety ahead of him may stir an exhausted man to greater efforts. On the other hand, failure in the face of necessity may also serve as a spur. It is the actual *outcome* which is important; either affective property may determine it. Punishment, within limits, may be as effective as reward. Again, recitation serves to reveal weaknesses. Like an experiment, it enables an individual to check, observe and discover. Moreover, it tends to reënforce the intention to learn. One who is willing to attempt recitation must be more interested in getting results than the individual who will not do so. His determination is accordingly

strengthened. Furthermore, recitation definitely implies that a forward-reaching meaning exists in a formalized learning situation. The learner is preparing to function in the future; what he now does is really what he plans (hopes) to do later. The results of quantitative studies on recitation reveal that twice as many nonsense syllables may be learned, when individuals spend 80 per cent of a study period in silent recitation than when they devote a whole period to reading.

h. Repetition. 1. *Its Significance.* Practice, we are told, makes for perfection. Disregarding perfection, we know that repeated observation is accompanied by significant changes. But mere repetition without observation (where there is no intention and need) can do nothing. Where the same situation (object) is repeatedly faced, one gradually comes to learn more about it. In every case, functional output is limited partly by time. Man may not learn about the size and shape of objects if he is given only a short time in which to observe their *color* properties. Repetition is important because it permits the emergence of new and different properties. More *meaning* appears under repetition; continued observation commonly contributes to discovery. The necessary shifts in intention which every individual can observe is of paramount importance in repetition. But intention (and observation) cannot change many times in a very short period. With the longer time given through repetition, an individual may stress various features. Moreover, repetition as in the case of learning nonsense syllables permits grouping into meaningful patterns. Relational properties appear in this manner. It is generally recognized that a learner groups and regroups the materials of a situation until a single organized whole is developed — until the whole thing "makes sense." Where conditions are appropriate, rhythm and rhyming may also facilitate learning. The importance of such factors at the childish level is universally emphasized. A few rhyming words may actually dominate a mass of material and so contribute to its organization.

2. *Maze Studies.* The ordinary maze situation, of which one form is shown in Fig. 100, furnishes the psychologist a device for studying certain changes which occur in functional products under repetition. This maze has a number of blind alleys opening off from a single pathway which leads from a starting point to a goal. Mastery is assumed when an individual moves from start to goal

without entering a blind alley or without retracing the pathway. The maze enables the psychologist to investigate such factors as the total time, the total number of errors made in all blind alleys, the number of repetitions (trials) required, the order (sequence) in which the various errors (blind alleys) are eliminated, the number of times each blind alley is entered, and the parts that observation and intention play. He can also study the effect of different forms of reward and punishment (shock, knowledge, praise, condemnation, etc.). Such factors as psychological age, intelligence, previous training, and emotional stability may also be investigated. Figure 101 shows two curves from some studies on maze learning at two age levels (Carr and Hicks).

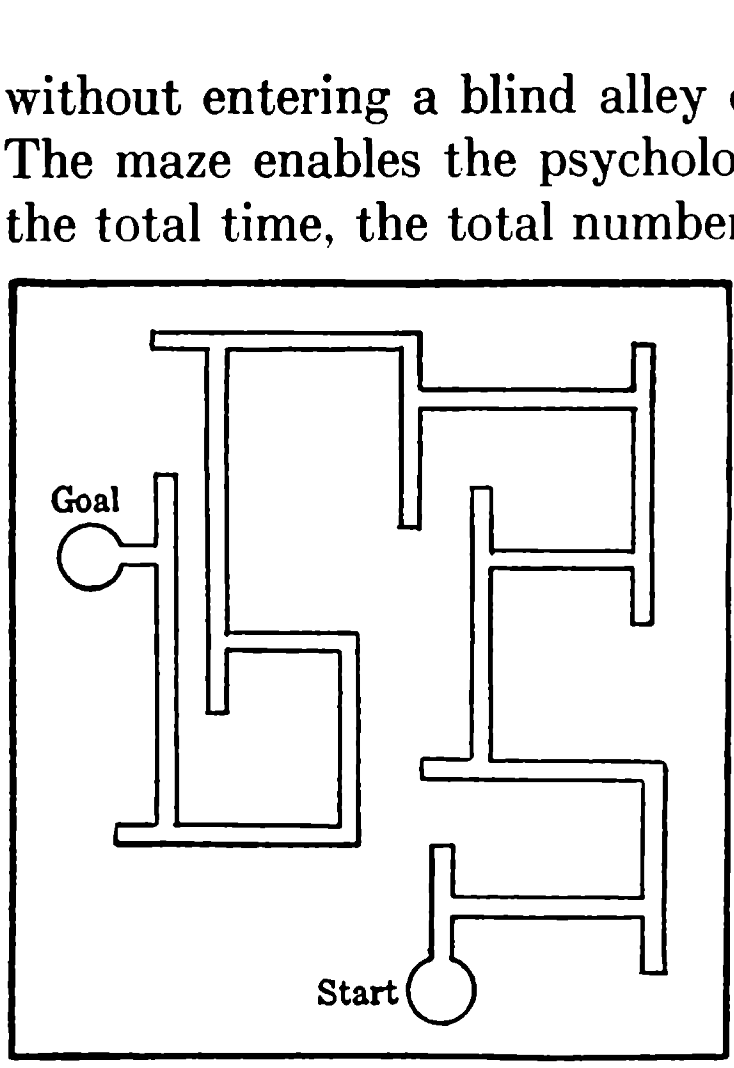

Fig. 100. A diagram of a maze pattern.

Individuals seemingly tend to learn a *true* pathway in the maze which may be partly independent of the blind alleys. Experimental results reveal that every blind alley may be repeatedly entered at various times during the whole learning period. But when the subject is asked immediately following learning to

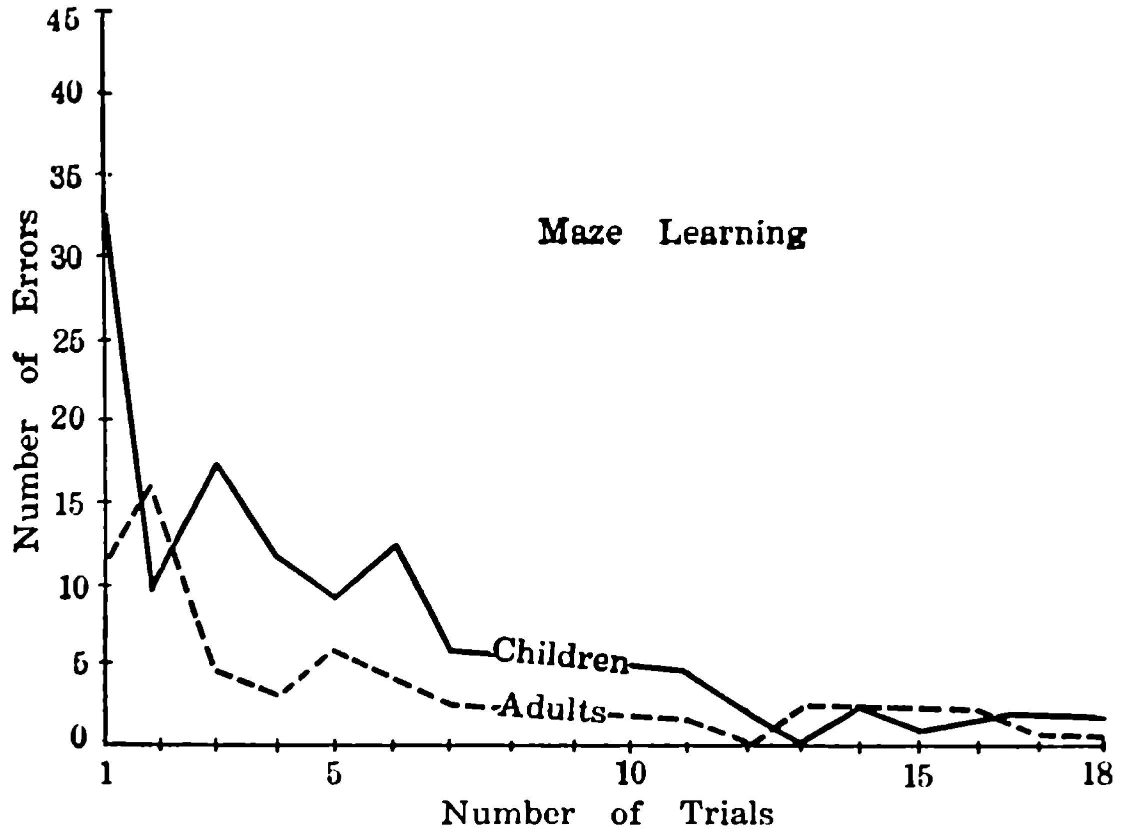

Fig. 101. Which is more efficient — child or adult?

draw the pattern accurately and to place upon it the relative position and shape of each blind alley, he is seldom able to indicate many of the various positions. The average number of blind alleys correctly recalled by a group of college students following learning was 3 out of a possible 10. One student, for example, took 60 trials to learn and made 454 errors. But he was able to recall correctly the places of only 3 blind alleys. The greatest number was 7 and the least was zero. More of the blind alleys correctly placed fall among the first five. Most students can give very little information concerning the shape (dimensions) of the blind alleys. The subjects usually report that they were thinking about getting to the end by the correct way and not about the various alleys. The intention is to learn one thing (pathway) and not other things — blind alleys. Finally, subjects will occasionally incorporate a blind alley into the final pattern and carry it as an integral part. Until they discover their mistake through observation (or being told) they do not recognize it to be such. The elimination of errors or the learning of a correct path is not done blindly or mechanically. It consists of a series of meaningful changes carried on at the level of observation under a particular intention. It involves the establishment of an orderly arranged pattern within a particular situation.

3. *Learning Curves.* Some of the functional changes, measured in terms of products, which occur under repetition are commonly shown by learning curves. Such graphs are drawn to reveal the time required, the errors made, the number of trials necessary for learning as well as the actual amount learned. The amount to be learned may be held constant as in a maze and the progress toward mastery may be graphically represented. Figure 102 shows the decline in the number of errors occurring from trial to trial in a maze situation. Similar curves are often drawn for time. Under these learning conditions, the number of errors and the amount of time are large on initial trials; but each shows a rapid drop. As time gradually shortens, the number of errors must also drop. The student will understand that there is no one learning curve for all situations and tasks; each task is somewhat unique. Some curves show a rapid rise, followed by a slower rate. Such curves represent cases in which learning is negatively accelerated. Other curves indicate that changes seemingly occur slowly at first, then more rapidly later. Such curves are said to be positively accel-

erated. The first imply that the tasks are relatively easy in the beginning; the second, that they are more difficult.

Some learning curves show flat stretches which presumably mark periods of little functional change. These are called plateaus. Some students hold the plateau to be a resultant of various causal factors becoming fairly stabilized. Some one or more of these causal conditions may then be changed or new factors may be introduced, with a resulting change in functional output. We recognize that men sometimes push rapidly ahead when they are

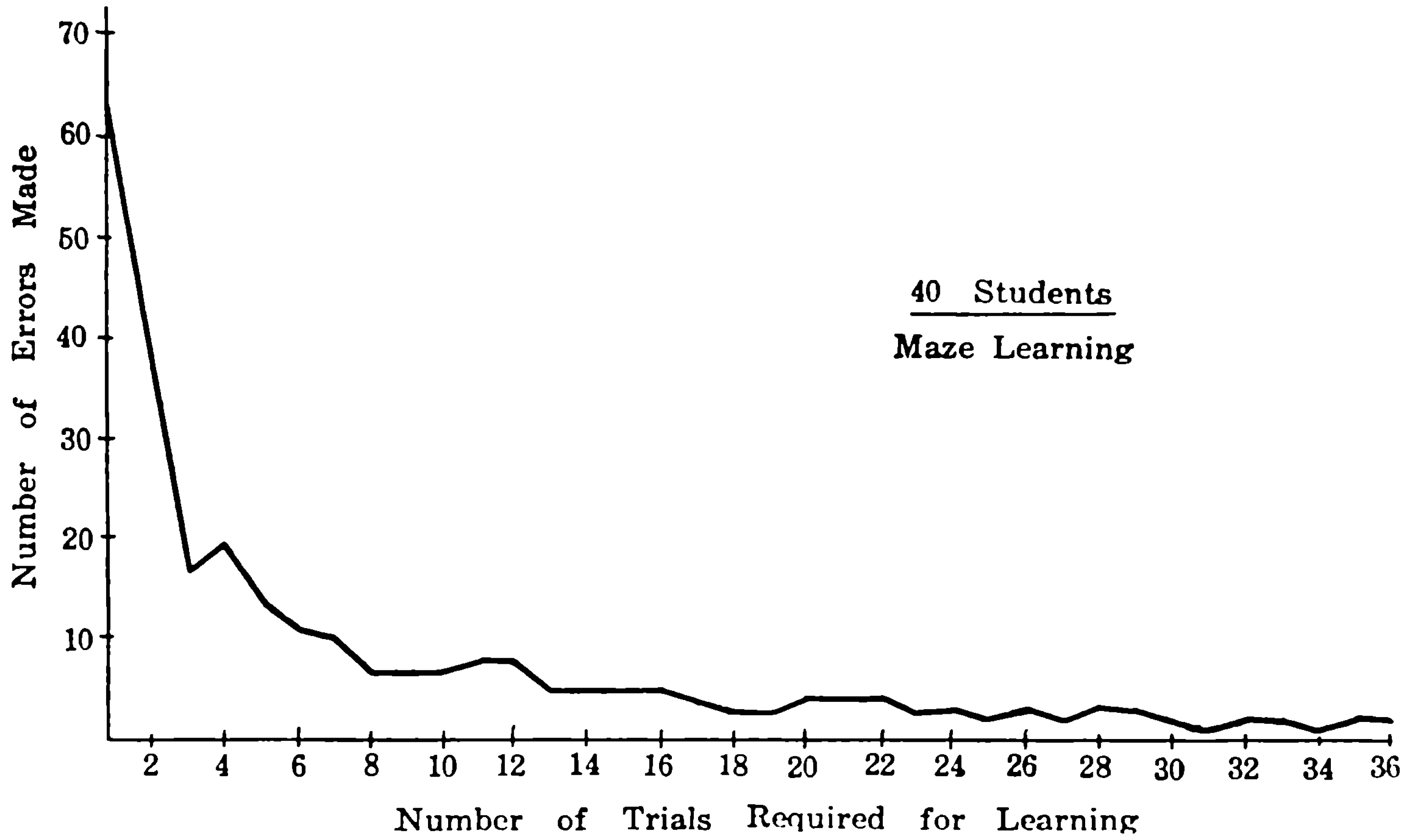

Fig. 102. A graphic representation of maze performance. Compare the first four trials with the remainder.

transferred (promoted), or when a new intention or desire such as may arise from falling in love is introduced, or when a favorable change is made in the mode of attacking a situation, or when increased understanding is obtained. It is probably true that most plateaus are due to psychological conditions involving purpose, intention, interest, determination, and mode of attack. It is possible, in some cases, that the period of no change is due to the individual's having reached his physiological limit — an assumption which is difficult to sustain. Where the various causal conditions are kept quite constant, as they commonly are in the case of animals, no such plateaus occur. This fact tends to indicate that the major causes are actually psychological. Plateaus occur in cases of human learning because man, for instance, becomes satisfied; he does not attempt to push on.

i. Distribution of Material — Whole vs. Part. A great deal of work has been done upon the problem of the comparative value of the part method and the whole method as determining rate and amount of learning. In the case of poetry, for instance, the "part" method might result in learning a few lines before passing on to others. The "whole" method might result in reading a hundred lines through each time until all are learned. In certain cases, it appears that breaking the materials into parts tends to increase the rate of learning. Some data indicate that children learn poetry by part better than they do by whole. The whole method generally tends to require fewer repetitions but longer time, unless the rate is definitely fixed (controlled). The whole method may be more efficient for learning some materials, such as vocabularies as McGeoch suggests, but no better than the part method for other materials. The part method gives definite encouragement thereby facilitating mastery (Reed), because the individual can actually check upon his immediate achievement. The whole, on the other hand, gives larger meaningful units and provides less chance for disruption. In general, we must say that no particular method holds for all learning situations. The better method must depend upon the kind and the amount of the materials, the age and the functional abilities, as well as the personal history of the learner.

j. Distribution of Work Periods. The arrangement and the length of the several learning periods also play a part. Here again the causal factors seem mainly to be psychological. Long working periods tend to produce boredom and loss of desire to *achieve*. Short periods apparently contribute to increased enthusiasm and greater satisfaction. When the individual understands that his time is definitely limited he may tend to work more intensively and with a stronger determination to achieve. A *physiological* factor affecting learning might concern a possible tendency toward neural perseveration following a work period. That is, the nervous system might possibly continue to function for a short time after a stimulus source has been withdrawn and after the individual ceases to observe. Jost, for example, assumes that after each working period, the neural basis persists for a time and thereby increases (sets) the strength of the neural side. He holds this to be true regardless of the actual *number* of repetitions (few or many) in each work period. Measured in terms of the amount produced sub-

sequently, he found among other results that two repetitions per day distributed over *twelve* days were more effective than four repetitions over six days and even more effective than eight trials upon three successive days. There are more *periods* in a 12-day series for the "setting process" to occur. In general, it seems that some distribution of this sort is distinctly favorable to learning. Figure 103 shows differences in achievement under four conditions of distributed practice. The working time was 120 minutes. Group *A* worked ten minutes twice a day for six days. Group *B* worked 20 minutes per day for six days. Group *C* worked forty minutes each day for three days. And Group *D* worked the full period in one day. Group *A* was the most efficient.

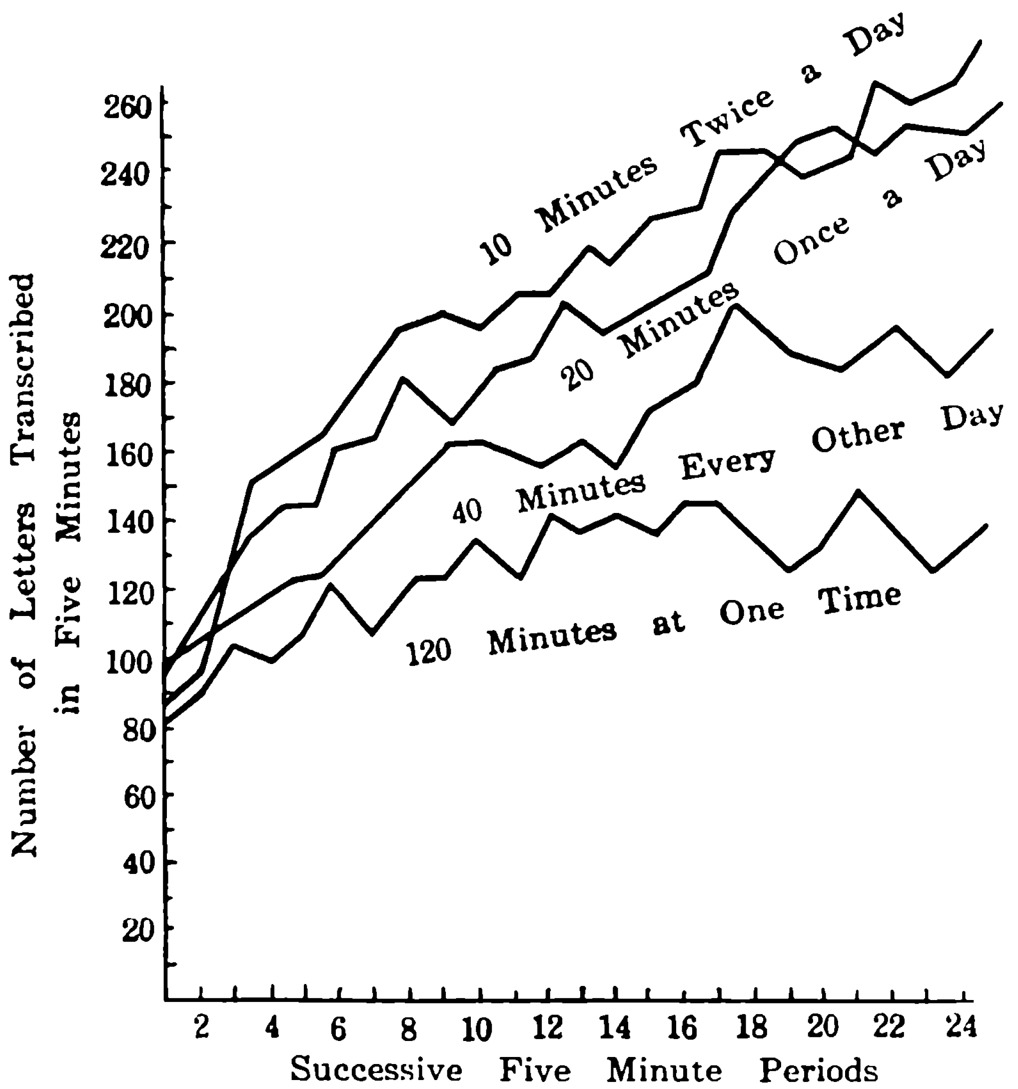

FIG. 103. Distribution of working periods serves as a causal factor.

k. Amount of Material. Every individual recognizes, of course, that under certain conditions more material requires more time and effort to learn. Each individual apparently has a functional limit, measured in terms of the actual extent of his learning at any given moment. The amount varies with different individuals and with the same individual. In each case, however, there is a *span*, which depends upon various factors such as chronological age, mental age, intention, understanding, and relevance. It is recognized that less time and fewer trials may be required to learn much longer lists, if the materials are more significant. Other factors equal, more *familiar* and understandable material can be grasped in larger amounts. Laboratory studies have sought to quantify the actual effects of increasing the amount of material. The measures are commonly put in terms of number of trials and

the amount of time. Figure 104 shows the number of trials required to learn different nonsense lists of varying lengths. It is evident that when an individual passes beyond his limit (perhaps, seven syllables), a slight increase in the amount of material is considerably more expensive in terms of trials. That is, if one can grasp seven syllables at one reading, he does not require merely two readings to be able to reproduce fourteen items. His span may be seven syllables; but if ten are given he may actually report but *three* (or four) and these may be among the very first and the last. His production depends in part upon his mode of attack. If he knows, for example, that he has ten items to learn, he may consider the first four or five and then not even look at the others until later trials. Moreover, if he is forced to learn the syllables in the actual order in which they are presented, the time of learning will be increased. The order itself is actually a fairly expensive meaning.

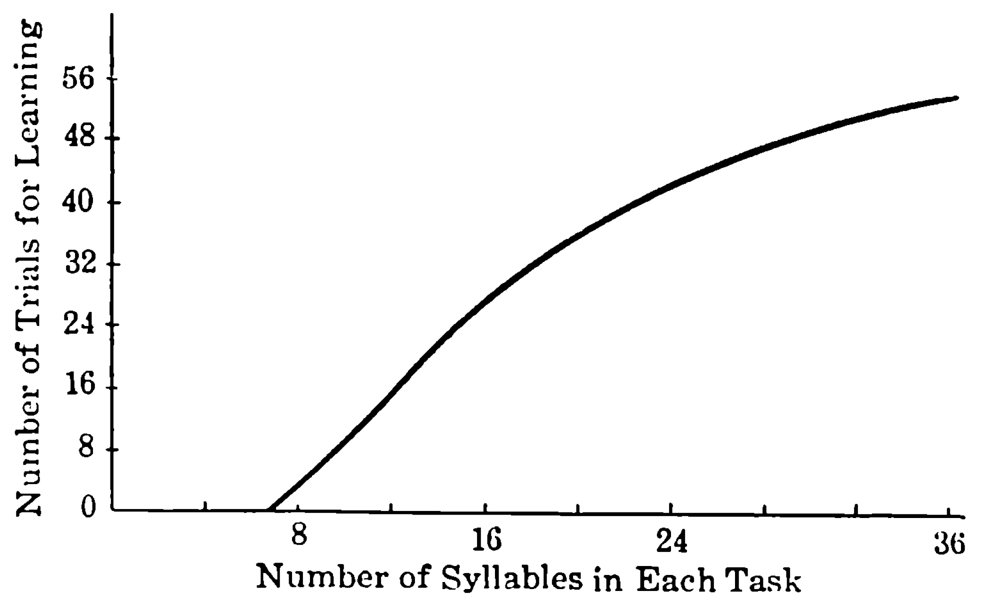

Fig. 104. How does difficulty increase with an increase in amount to be learned?

F *Retention and Forgetting*

Learning as we consider it actually consists of two gross divisions, *namely*, (1) the production of a functional change which can be known only in terms of (2) the nature of the functional products at a subsequent time. The test of learning is what is done — what an individual can later do (on a task) that he could not earlier do. Here, as in other cases, the matter reduces to the functional products within a situation. There is this difference, however, that one situation is compared with another situation. To understand learning, the student must recognize that nothing is *recalled* in the sense of anything being *revived*. This is to say, an individual functions in one manner at one moment; and he functions in another manner at another moment. In so far as the difference in products is the result of his own personal history and endeavor we describe them as being learned.

a. Test of Learning. No one ever observes a learning process. One does observe, however, that functional products — perceptual, actional, etc., — differ from time to time. Before and After are causally related; and the causal factors producing the differences are referred to as the conditions of learning. Let us ask: How much has a person learned or to what extent has he been functionally changed in a particular situation? The answer depends in part upon when he is tested — a day, a month, or a year. A person may face a learning situation and then at the very moment of his test there may be some emotional condition which makes it seem that he learned nothing. At a later time, however, he may actually be able to report a considerable amount of material. The test of

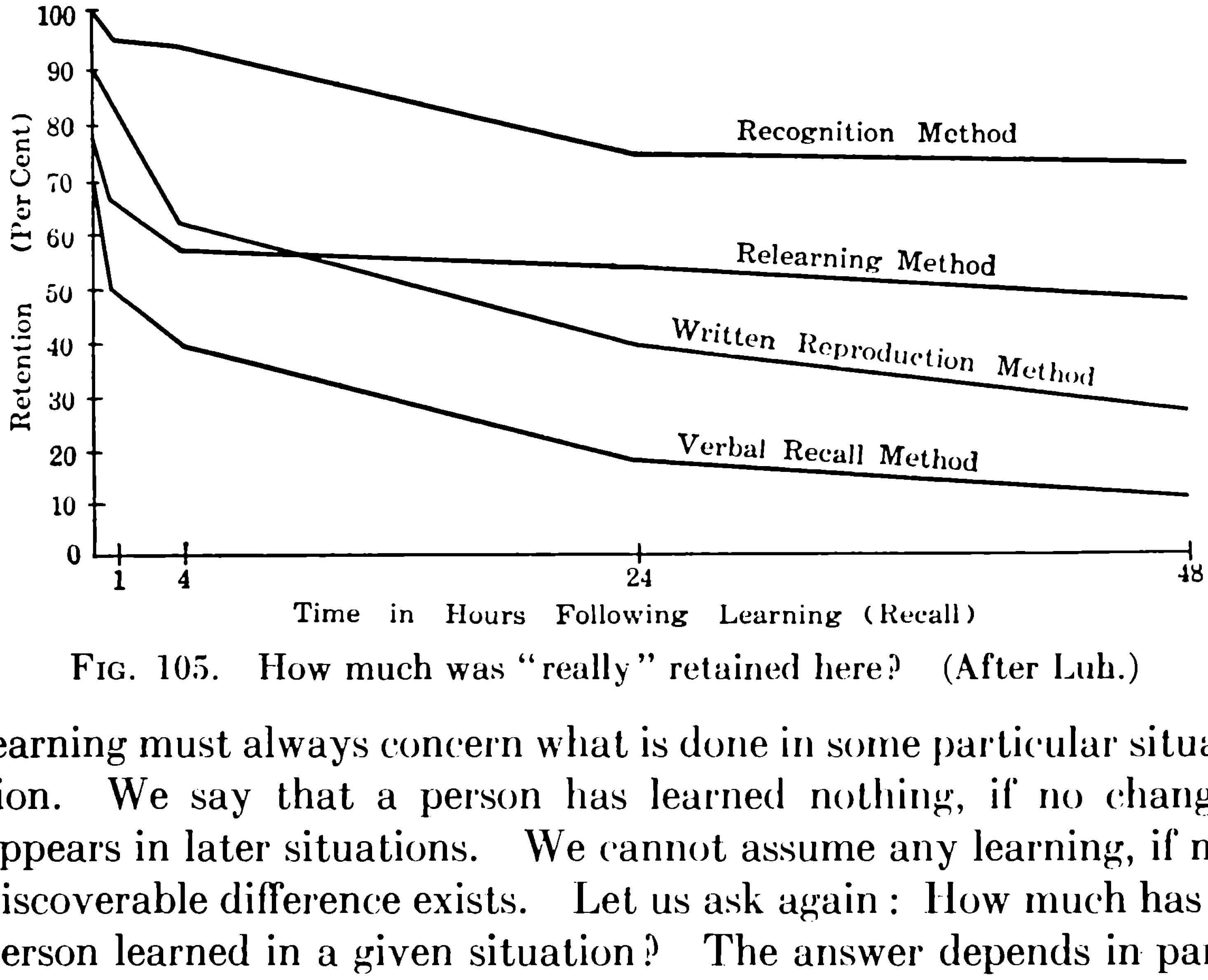

FIG. 105. How much was "really" retained here? (After Luh.)

learning must always concern what is done in some particular situation. We say that a person has learned nothing, if no change appears in later situations. We cannot assume any learning, if no discoverable difference exists. Let us ask again: How much has a person learned in a given situation? The answer depends in part upon the actual methods of testing; upon the nature of the particular situational demand laid upon the individual. This should be clearly understood; it is significant. Figure 105 shows unlike amounts of learning as measured in different ways. The student should raise the question here: Which of these really is a "true" measure of learning? We can then say that there is no one true method. The attempt to produce materials *verbally* gives one amount; to try to produce them by way of so-called *recognition* gives quite a different amount. The two situations are actually

different, and the functional output is different. Looking at this matter from one angle, we can say that one actually learns more as measured by the recognition method than he does by the verbal method. Or looking at it in another way, we can say that one produces more, of *what* he learned, when measured by the recognition method than he does when measured by the verbal method. We can also say that he retains more when tested by one method than by another.

b. Some Methods of Testing. In the method of verbal recall, the situation to be learned is presented to the learner after which he is asked to report upon it. The amount correctly produced is a measure of both learning and retention. The time of the latter is, of course, kept constant if the rate of learning is being studied. Common use is made of "paired associates," for instance, *zom—fex*. The first item may be given by the experimenter and the second is to be reported by the subject. In the recognition method, an individual studies a number of objects. These are then mixed with other unstudied objects. The subject is then required to report upon (indicate) the familiar objects. In the method of relearning, an individual may possibly require *ten* repetitions in order to learn some task. At the end of the waiting period (e.g., two days), he may again need *five* repetitions in order to relearn. The measure of his relearning is commonly taken by the method of verbal or written report. The difference here between the first and second learning represents a saving of 50 per cent (5 to 10). The *saving* itself may be measured either by amount of time or by number of presentations necessary for learning. If it took 80 minutes to learn the first time and 20 minutes to learn the same materials a second time, the saving is 60 minutes or 75 per cent (of 80). It is understood that if there had been no functional change persisting at the time of the relearning, it would theoretically have again taken ten repetitions (or 80 minutes) to satisfy the situation. The fourth method shown here is significant especially in that it shows an individual producing more items by writing than by verbal report. It should be quite evident, therefore, that different tests give different results. The nature of the situational task definitely affects the total character of the functional output or product. Verbal report, for example, involves the organism in one way; the products of recognition, however, must issue in a different way. They are clearly more of the latter than of the former.

Recognition is easier than verbal description. It cannot be seriously maintained that the organism functions in the same way in both cases if the products, as shown here, are so different.

c. Nature and Amount of Learning. Where the material is familiar and understandable, the functional changes as measured in terms of what is done in particular situations tend to persist much longer than where there is little understanding. It is generally recognized that understanding a situation definitely tends to increase its persistence. The organism can produce it more readily and over a longer time. One student reports a saving of 20 per cent in relearning poetry after a period of seventeen years (Ebbinghaus). This is to be compared with a like saving at the end of one *month* when nonsense materials are used. Moreover, the amount of materials learned tends to affect the amount later produced. Within limits, one seemingly forgets less when more has been learned. Some experimental data indicate that when twelve nonsense syllables were to be learned, a retention around 30 per cent was obtained. When the number of syllables was trebled, however, the per cent retained was almost doubled. A major causal factor in such cases probably concerns the actual degree of mastery. The larger number of repetitions required to learn all thirty-six syllables resulted in the development of a closer integration among some of them. It is recognized that the whole method normally contributes to the "over learning" of certain easy portions while the difficult portions are being integrated. As evidence of the nature of the task, we point out that the functional changes such as occur in learning a maze situation appear to persist longer than those involved in learning nonsense objects. Fewer errors are made and less time is required in relearning maze patterns. Some of this difference may be due in part to the methods of testing retention. The saving method gave the above results. But the very nature of the maze task, we suggest, offers more chance for *recognition* than does the relearning of nonsense materials by the saving method. And, as we have seen, the so-called recognition method of testing retention gives the highest production score.

d. Retroactive Inhibition. Various sources of evidence indicate that, in certain cases, the degree of functional persistence, as measured in terms of products, may be affected by what is observed during the period immediately following a learning situation. That which comes after may thus interfere with that which goes

before. Such possible effects are referred to retroactive inhibition. When two learning situations which are somewhat similar occur in succession, the one may affect the other. Confusion then appears in the later reports. Where there is no similarity, no such confusion may be assumed to occur. Although the evidence is ambiguous, it is claimed that little or no disturbance may occur when the second situation is delayed as much as five minutes. Whatever the degree of functional persistence, which may *possibly* exist from the first situation to be affected by the second situation, it is usually of short duration. Again, overlearning, that is, continued repetition after certain criteria of learning have been satisfied, seems to offset any such disturbing effects of later activities. In this connection we must point out that the superiority which may follow the longer rest periods may actually be due to unpreventable rehearsals of the materials, thereby contributing to overlearning. As a matter of fact, students frequently report that although they do not wish to do so they may suddenly recall the experimental materials. Moreover, functional persistence seems to be less affected by periods of sleep. That a sleeping period should be followed by the production of a larger number of learned items than a waking period of the same length has specific theoretical value. It implies that forgetting is significantly due to the way in which the brain functions from moment to moment to produce meaningful situations. As a striking illustration in this connection, we point to the destructive effects of an emotional situation upon immediately preceding or following events. Finally, we indicate that an individual may be quite unable to describe the various events of a hypnotic period. The hypnotized individual may be told that he will not be able to recall anything which occurred during the experimental (hypnotic) period. In many cases, this instruction is actually sufficient to inhibit later reports. In these cases, of course, the factor of similarity does not enter.

e. Effect of Time and Curves of Forgetting. The laboratory has been used to quantify the influence of time upon the persistence of functional changes. Many factors are necessarily concerned here, among which are the nature and amount of material, the intention and intelligence of the learning, and the nature of the methods used in testing retention. We have touched briefly upon these conditions. Other things equal, we know that time tends to affect the integration of patterns — situations may no longer be

produced in terms of their former meanings. What is the nature of such progressive losses and how are they determined? Two methods are commonly employed. In the one, different lists of materials (tasks) of *equal* difficulty are learned by various subjects and are reported upon after different lengths of delay. One list may be tested in five minutes; but another list may go for several months. In the other method, a number of individuals learn the same materials. Some subjects are then tested at the end of one period, and others are tested following other periods of delay. We have previously referred to the use of this particular method in the study of the effects of motion pictures upon children and adults.

Figures 106 and 107 reveal some rates of forgetting (losses) at

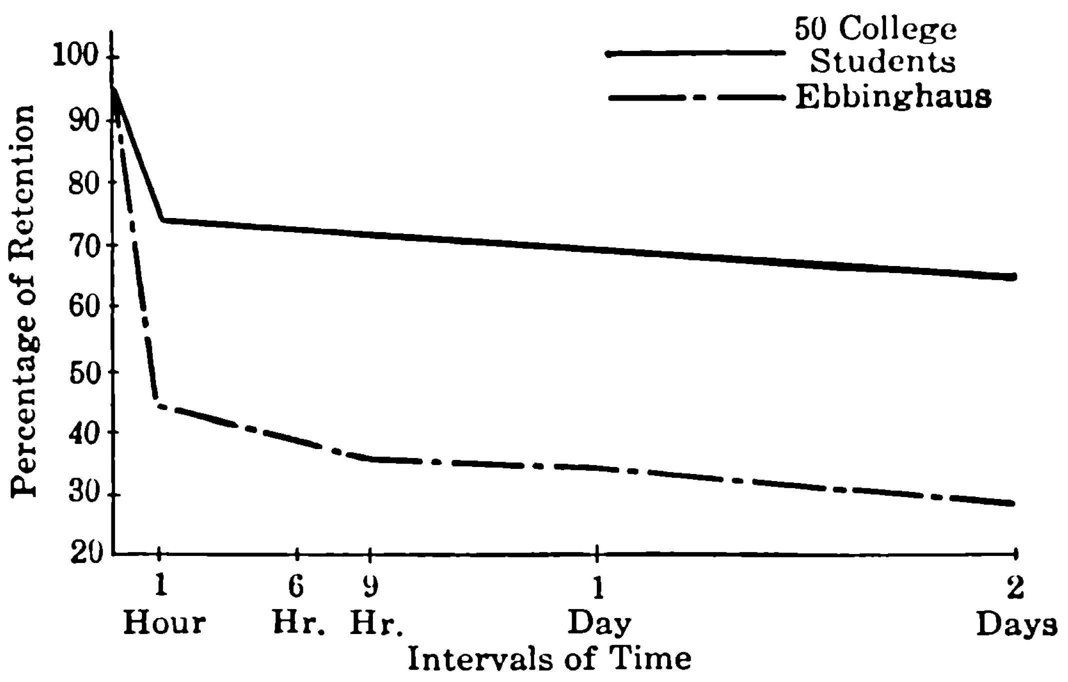

FIG. 106. What is the most striking feature of the losses represented here?

varying periods. Figure 106 shows a curve based upon the results obtained by one subject (Ebbinghaus). The other curve shows the combined results of a group of subjects. Each shows an initial rapid drop followed by a slower fall. Figure 107 shows the degree of student retention for materials of two college courses based upon a fairly extended period. In these latter cases the method of verbal report was used in the testing. If recognition had been employed as a measure, the scores would undoubtedly have been considerably higher. These latter curves are rather interesting because they deal with meaningful materials spread over a semester's study. If they may be taken as representative of actual achievement, they show the degree to which formalized instruction in these courses at the college level affects individuals within this time period and as measured by a particular method. A significantly large percentage of functional change as measured by the

initial score (76 for zoölogy and 70 for psychology) is forgotten by the time the new semester opens the following fall (30 per cent drop, or around 40 per cent based upon the spring score). A knowledge of results of this nature is necessary if any constructive program of teaching is to be initiated. Such results also offer the individuals of a particular course a quantitative basis upon which to plot any subsequent improvement in efficiency. We suggest, however, that the losses shown here are not due wholly to ineffective methods of instruction. They are due in part to a lack of affective value (indifference), and in part to the degree of understanding at the student level. As confirmatory evidence of this fact, the student is again referred to the studies

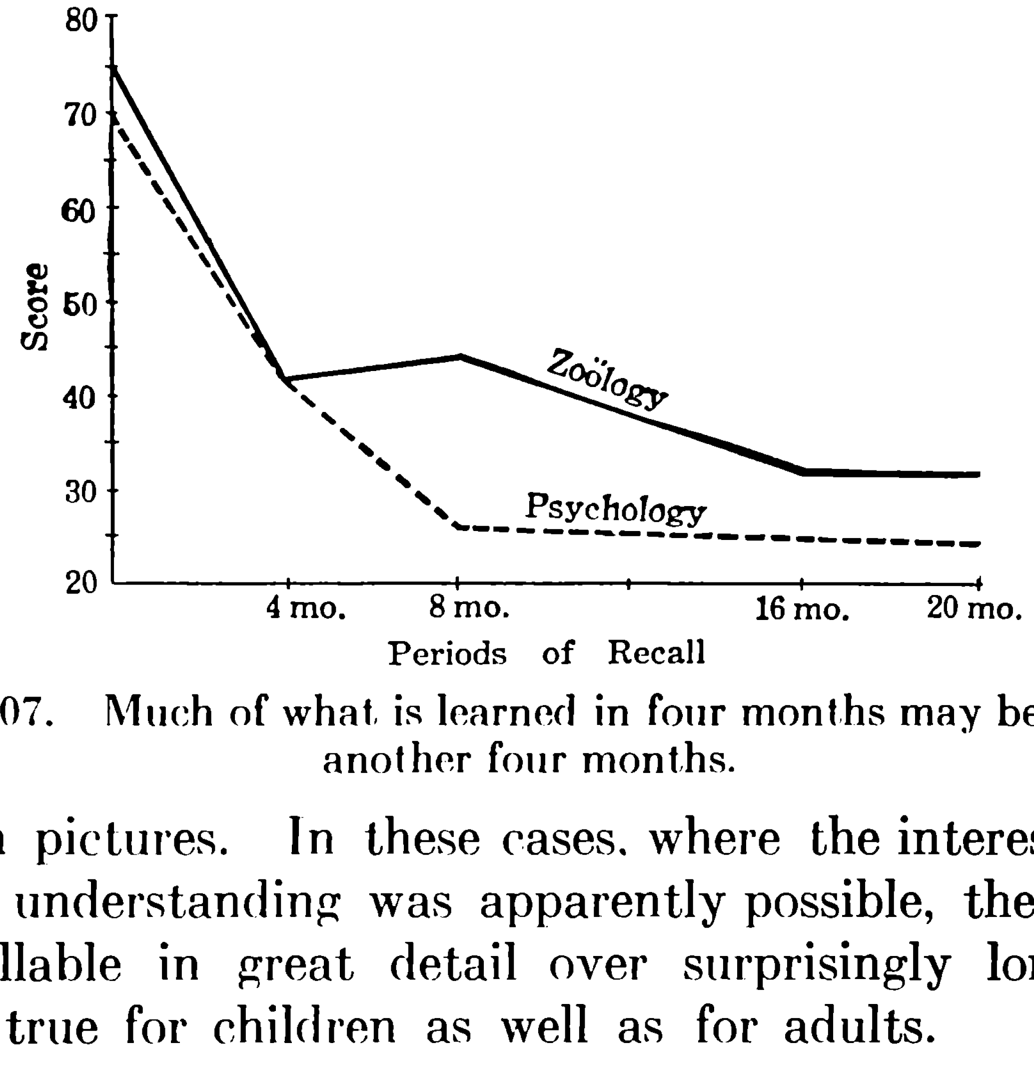

FIG. 107. Much of what is learned in four months may be lost in another four months.

on motion pictures. In these cases, where the interest was high and a full understanding was apparently possible, the situations were recallable in great detail over surprisingly long periods. This was true for children as well as for adults.

G. *Transfer of Training*

a. Its Nature. A larger degree of understanding concerning the nature of learning may be secured from a consideration of studies of transfer of training. The employment of one hand in a simple situation shows how such learning actually affects an organism. The use of the right hand in a motor task may greatly increase the efficiency of the left hand, or even the right or the left foot. Figure 108 shows a curve (*R*) based upon training given the right hand by tracing 12 stars like that shown in Fig. 109. These stars were seen in a *mirror*. The individual had, therefore, to establish new

eye-hand coördination-patterns (mirror patterns). The other curve (*L*) shows the influence of such right-hand training upon the left hand where stars were traced by the left hand following right-hand learning. The time actually falls below that of the right hand. Although the one hand may not be directly involved, its improvement may possibly equal that of the employed hand. As we shall shortly show, Lashley found that the monkey which was paralyzed in its left arm during the time it was learning a task with its right arm, was able to work as effectively with the left arm when it recovered (without training) as it did with its trained right arm. Results which confirm transfer have also been obtained from studies upon the use of either hand in the operation of adding machines. Such results doubtless depend in part upon other factors, such as greater familiarity with task, greater skill in reading the materials, decline in distractive effects, increased confidence, and freedom from fatigue. But the recognition of these facts does not obscure the effect of transfer. In fact, it only tends to reveal more clearly the particular nature of learning in such tasks. It must be understood that a great deal of transfer occurs in learning situations which are similar in terms of particular observed characteristics; experimental studies on puzzle solving show this to be true. When similarities are observed, efficiency is definitely increased. We can likewise understand the fear of a young child for various woolly things after it has been frightened by one woolly thing. All objects which have this common property or meaningful characteristic may now be reacted to by the child in a similar manner. There is no reasoning involved in such cases. But there is a common perceptual property in several different classes of objects.

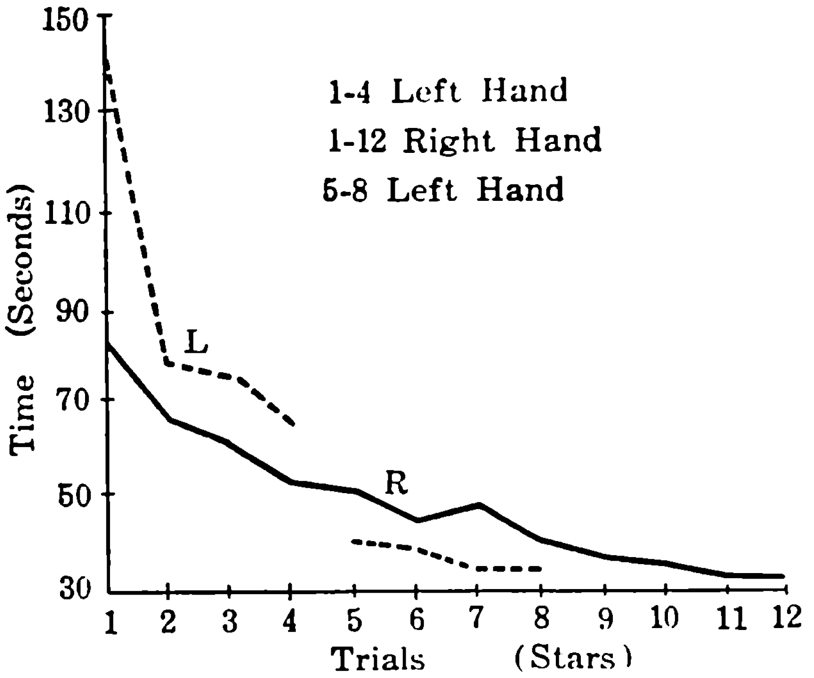

Fig. 108. Note how the left hand profited from the training of the right hand.

b. Understanding and Thinking. Transfer may also occur at the level of understanding and thinking. An experimenter taught two groups of individuals to shoot at a target under water. The one group was definitely informed concerning the effects of water

upon light rays. They were given an understanding of the fundamental principles involved. The other group was given no coaching. The informed group transferred its knowledge of physical conditions to the particular situation. Their scores were better than those of the uninformed group. We recognize, moreover, that the effects of one situation upon another may hinder as readily as it helps. An individual may attack a new situation in terms of some old satisfactory situation. But if a slightly different method happens to be necessary and if the individual persists in using his former satisfactory methods, inefficiency must ensue. Such interference is commonly called negative transfer. Where the effects of one situation increases efficiency, the transfer is positive.

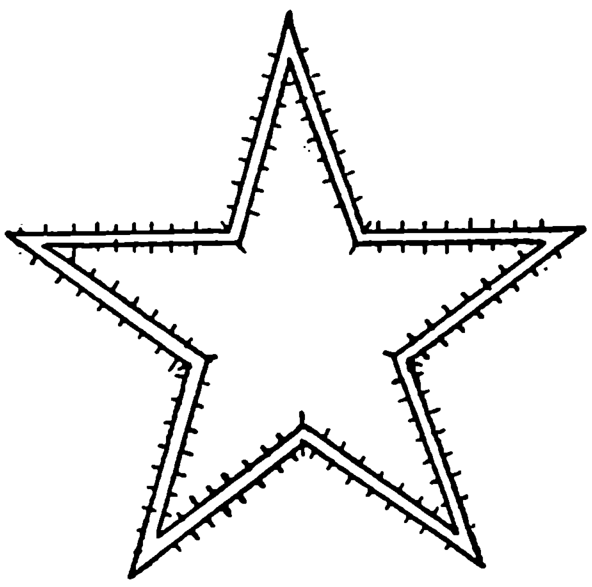

FIG. 109. A diagram used in studies of transfer.

c. Scientific Neglect — Specific Stimulus and Response Position. A few psychologists, for various theoretical reasons, have failed to recognize the significance of transfer. Some who have tended to stress specific habits and precise *neural* bonds between physical stimulus and organic response have ignored the large possibilities of transfer. Of course, if each particular stimulus were *mechanically* to produce its own separate pathway in the brain, there could be no transfer. Each human response would be wholly comparable to each movement of a puppet pulled by a separate string. Transfer, however, is a phenomenon which may easily be found in many ordinary life situations. A man may never have used his left hand in various tasks. But if necessary, he can immediately sign his name, or he can shift gears, or drive a nail with it. One does not necessarily need to learn in every new situation to be clean or industrious or honest or polite. One can establish goals or standards or ideals which may significantly determine, over a long period, the nature of his actions in various situations. We do not imply that if a man is honest in one situation, he will necessarily be in all situations. There is no general honesty. As a matter of fact, however, life actually proceeds upon the assumption that man who has shown certain ideals and standards under particular conditions may be expected to show them under like situations unless some *new determining factor enters.*

d. Identical Elements. It has been assumed that transfer occurs in situations which possess identical elements. We assume that such identical elements are really meaningful characteristics. They are not, for instance, identical elements in the nervous system. No evidence indicates that transfer involving distinct elements ever occurs at a submeaningful level — there are merely shifts in energy patterns. Whatever is transferred is a matter of observation — of meanings. If an individual is trained in such a way that he seeks to discover common meanings in life situations, he is well-taught as far as possible transfer may be concerned. Through understanding, an individual is enabled to observe relationships in a given situation — that is, a meaning common to another situation. As evidence of the extent of transfer, we turn to the results of an elaborate analysis of all studies dealing with the problem of transfer conducted between 1890 and 1928.[1] The comparative data, shown in Fig. 110, indicate that 50 per cent of the experimenters found an "appreciable" amount, and that 32 per cent reported a "considerable" amount of transfer. Here is a total of 82 per cent. In the 99 studies covered, less transfer was reported at the level of perception than at the level of understanding and reasoning. The evidence seems unambiguous. The human organism is apparently capable, under proper conditions, of discovering meaningful characteristics in later situations which are similar to those of earlier situations. Life, we assume, is fairly continuous. Contiguity, at a psychological level, rests definitely upon a meaningful basis.

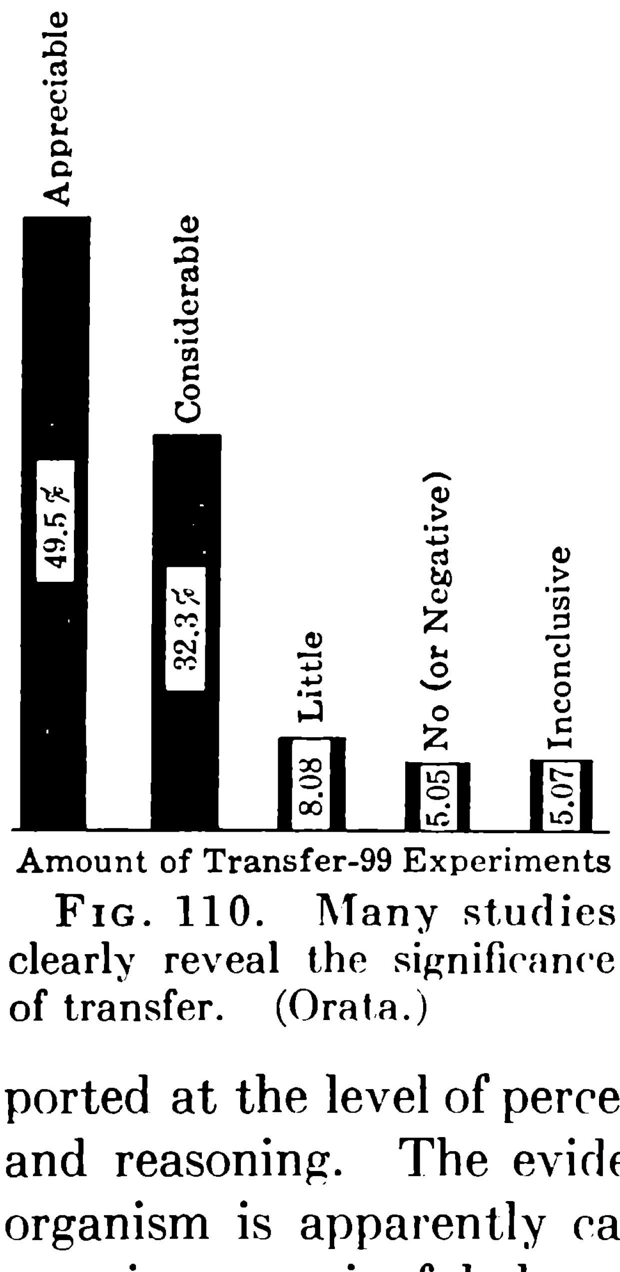

FIG. 110. Many studies clearly reveal the significance of transfer. (Orata.)

H. *Explanation*

a. An Orientation. We have briefly reviewed some phases of learning. We have found no distinct learning process which can be isolated from man's various forms of functioning and described in

[1] See Orata, P., *The Theory of Identical Elements.* Ohio State Press.

unique terms. Learning, we have seen, is simply a phase of function — of perceiving, acting, thinking, etc. Changes undoubtedly occur in observable products; meaningful characteristics change from time to time. New properties emerge; old properties drop out; objects assume order, coherence, and sequence; situations become enlarged and simplified; sources of enduring satisfaction are discovered; specific patterns of actions are established with respect to meaningful features of things. There is isolation on the side of observation and selection on the side of action. Life situations are so complex, the demands upon the organism are so varied, the causal factors are so delicately balanced, and change is so very easy that chaos should seemingly be the rule rather than the exception. But the organism is given stability as well as functional direction through its hereditary equipment of needs and desires with their accompanying forms of satisfaction. Man is inherently constituted to be satisfied under certain situations. The race has actually so endowed him that he pushes out toward the world in his endless search for sources of satisfaction. And through perception, memory, imagination, action, and thinking he discovers them in their various forms. As he strives, he constantly changes. Some forms of these modifications are learning. We want to look at a few explanations of such modifications. We shall discuss conditioned reflex, trial-and-error and situational (field) theories. We shall find no *one way wholly adequate*. There is, we recognize, no one final explanation of all functional changes. We shall accordingly discuss this general problem realizing full well that *to change* is the very nature of living things. Years ago, a most outstanding student of heredity stated that to change is an *inherent* property of all germinal plasm. In this way, for instance, he explained the origin of new forms of life (Weismann).

b. Conditioned Reflex Theory. Some men would seemingly attempt to explain all learning in terms of the principles of the conditioned reflex. In each case, there is a definite reflex to which new stimuli become effectively joined. Each action is based upon a specific natural or unlearned response. Realizing, however, the impossibility of finding physiological reflexes to which to attach new stimuli in conditioning, some would go so far as to speak of religious, social, and liberty reflexes. Unable to explain the products of reasoning, understanding, imagination, and memory in terms of observable *bodily functions* and their several products (as

in the case of salivation), they fall back upon purely hypothetical *internal* conditions. Something, it is argued, *must* be in the body to be conditioned in all these cases. It is recognized, of course, that in the case of reasoning, for instance, it cannot be such structures as the salivary glands or the stomach. But it is something of physiological nature.

Conditioning, sensibly regarded, finds a definite place and value in psychology. Its emphasis upon the importance of brain functioning is one good feature; it commonly finds the cortex to be a significant causal factor. But it unduly emphasizes simple reflex pathways between "stimulus and response," for which no adequate experimental sanction can be found. The significant studies of cortical functions (Lashley and Franz) have made it quite clear that the brain does not work in any piece-fashion. Single neurones are not chained together end-to-end. To the extent that the conditioned reflex theory is able to recognize that mass patterns of behavior emerge at first under a new environmental situation and that with time the action pattern by elimination becomes specific with respect to an observed property of the environment, it has value. We unquestionably assume that the dog, for example, responds in the experimental situation (of conditioning) to some meaningful characteristic — first perhaps to pain and later to sound. We suggest that this behavior of the dog is quite similar to the behavior of the young child which commonly responds at first in mass fashion to the observed properties of objects. But we cannot find in many cases any particular physiological function, as in the case of salivation, to which various situational objects may be conditioned. We know that the well-trained hunting dog, for example, will rapidly act in many unlike ways (barking, jumping, running, advancing, retreating, snipping) to some one object (a bear) in a way impossible to explain in terms of simple conditioning. If this is true of the animal, it is even more strikingly true of the human being.

Mass behavior, observation, selection, and specialization are features of a *possible* theory of conditioned reflexes which we can easily understand. We can also understand the particular conditioned response as in the case of salivation. We assume that the production of the saliva in an experimental situation is essentially an accessory phase of the animal's behavior just as it is an accessory phase of *eating*. It is merely one of a large number of products

which usually appear in the very beginning. It is strikingly similar, in this sense, to the widespread bodily reverberations in the case of an ordinary emotion. The particular situation offers food — the end accordingly concerns the satisfaction of an inherently determined need. But the end is not the secretion of saliva. Therefore, to deny food is shortly to destroy the outcome. If salivation itself were actually the end-result, we would assume that the animal must necessarily continue indefinitely to salivate in response to a particular situation in which the various factors were kept constant. Moreover, theoretically speaking, the extinction of salivation, if nothing more is concerned, should affect *subsequent* salivation. But the animal salivates as easily under new conditions of food satisfaction as it previously did, before extinction in the experimental situation occurred. The response of salivation, strictly speaking, is essentially like that to be found in a great many cases of behavior. A human being, for instance, may strike, or scream, or run, or hide, or do many other things in terms of a particular *end*-result — *namely*, the satisfaction of escaping. Each of these cannot be regarded as being learned in each particular situation. Nor is any one necessarily reasoned out before it appears. In considering learning, either among animals or human beings, we must always be guided by the nature of the particular situation — we must consider it always in terms of the major causal conditions which produced it, *namely*, the actual needs and forms of satisfaction of the organism.

c. Trial-and-Error Theory. 1. *Some General Features.* Here we find emphasis upon a (a) situation in which a particular end remains unchanged, but the nature of the action pattern changes from moment to moment under (b) the drive or push of the organism toward a particular form of satisfaction. Under desire, the organism is directed toward various phases of objects in its endeavor to secure gratification. It must necessarily discover the particular features of the object or objects in the situation which will contribute to this end. The typical situation in which trial-and-error learning occurs is one which presumably cannot be reasoned out, even if the organism were functionally equipped to do so. Its activities are accordingly (c) *random* within the limits of the situation. That is, if the momentary situation is one created out of hunger, the animal does not concern itself with its mate. It moves restlessly here and there — looking and trying — and it

eats upon finding food objects. Or, if a human being is learning a maze, he does not remove the stylus and spend his time playing with it. Particular movements within the maze situation may possibly be random, but the end is definitely fixed — the individual wishes to get through it. He moves here and there seeking the end until (d) *success* comes; then he stops. His attack is neither blind nor mechanical. He may accordingly try some particular plan of attack, such as holding the stylus against one side of the pathway. Here, again, his behavior is partly exploratory. As learning proceeds and the situation assumes familiarity, his behavior becomes less random and more directive. He observes and generally (e) *eliminates* the blind alleys, since they do not contribute to the particular *end*. Finally, the whole pattern is (f) *integrated* so that the individual may move from start to finish without error.

In many life situations, as well as in the laboratory maze, "useless" items may not be dropped out. A boxer, we know, may telegraph his punches; an industrial worker may make many unnecessary movements; and a lecturer may include many unnecessary "ers" and "wells." In the simple maze, if the individual is not observant, he may actually incorporate a blind alley into the final pattern. Why, we ask, is not every useless feature eliminated? If some are, why are not the others? Again, we suggest, that the sole *criterion of uselessness* is actually found in the result. Observation under desire is necessary in order to eliminate. If the boxer does not observe the useless features of his pattern or if the resulting end is satisfactory, *namely*, he knocks out his opponent, he may never "improve." It is well known that under some experimental conditions, animals may set up so-called "wrong habits" — behavior patterns which are undesirable from the experimenter's point-of-view. Since the animals discover satisfaction in a certain way under these conditions, they tend to continue without change. If the experimenter wishes other behavior of the animals, he must lay new demands upon them in order to secure a change.

2. *Exercise*. One explanation of the elimination of wrong and the establishment of right responses involves the concept of exercise. According to this assumption, continued use tends to strengthen and continued disuse tends to weaken *specific* neural bonds. The frequency with which a pattern is executed is itself supposed to strengthen the pattern; in short, repetition makes

one learn. We have said, however, that the concept of sheer repetition or frequency fails in part to clarify the picture of how functional changes actually occur. Repetition, we hold, must always work indirectly. It is not a causal factor; it merely allows other determining factors to become effective. The repetition of a poem, for instance, facilitates observation. New meanings which may definitely serve to integrate the whole pattern are thereby permitted to emerge. Moreover, the less meaningful parts gradually become more familiar (more meaningful). Here we have reached bedrock; for we must assume in the light of present knowledge that the emergence of meaning of *familiarity* rests directly upon an inherent condition of the functioning organism. That is, the ability to observe familiarity is as much unlearned as the ability to perceive bitterness. When, as a result either of repetition or of no repetition, something which is observed has become familiar, we have really done all we can with it in terms of explanation. The student will be properly guided if he realizes, for example, that the only significance which the commonly cited analogy of a muscle which becomes stronger with exercise has for an understanding of learning, concerns this point. It is, in short, the inherent nature of an exercised muscle to change its several structural and functional characteristics. The muscle does not learn this ability. No chemist or physiologist, for example, has ever given any adequate explanation concerning how training or exercise actually strengthens a muscle. To be specific, the continued use of an ordinary chemical substance, for instance an acid, does not increase its strength to the slightest degree. Repetition, we suggest, definitely results in the appearance of a new *psychological* characteristic, *namely*, familiarity. We *know* familiar things.

3. *Effect.* Learning situations which involve alternative meanings — a right and a wrong, a useless and a useful — are commonly characterized by affective properties. And these psychological properties are an inseparable part of the end-result. If man strives to reach a goal which satisfies, the goal certainly is a part of the end-result. Lacking satisfaction, there would be no goal. The various causal conditions, whatever their particular nature, which make the affective properties possible are also inseparable features of the total situation (both inside and outside the organism). We do not need, therefore, to talk of any "back-wash of feelings" from

the end to something preceding the end in order to affect the causal factors. The affective values of situations do not suddenly appear after some psychological pattern has been *finished.* On the contrary, the whole situation which has to do for instance with food is actually pleasant to the hungry organism. If it were not so, it would be difficult to understand the hungry animal's pulling at the leash and, if allowed, leading the experimenter to the experimental situation. The child or the adult definitely reports that certain things are pleasant and that other things are unpleasant. The little child, we have said, avoids the flame for the reason that, having been burned, the flame possesses new immediately observable characteristics. We suppose in no way that either the animal or the young child has to *remember* previous occasions with fire and their effects before it can successfully avoid the flame. Such psychological bases are not to be found even at the level of the intelligent adult who may actually report a large number of cases in which he knows things to be very pleasant or very unpleasant. Yet he may be unable to cite the slightest reason for such properties. He cannot remember why he likes one thing and dislikes another thing. The literature of the abnormal in particular is filled with such cases.

An organism, facing situations, functions continuously. It observes here and there. Under certain conditions, depending upon the situational demands, it may act continuously in terms of its observations. Permeating each learning situation at a psychological level is a need, desire, interest, purpose, or intention. We disregard all purely physiological changes. As satisfaction comes, the situation may change. At first, an organism may make many "unnecessary" movements as in learning a game (tennis). Shortly however, it reduces the breadth of its activities. It often does so even before it finally isolates each particular thing to observe and the exact way to act in order to secure maximum satisfaction. Under repetition, it is able to observe more and more precisely while being guided always by a particular need or end. Finally, we say, certain things, objects, characteristics stand out — they become dominant. They are now observed differently.

Punishment, we must assume, if not too strong, tends to make an organism more observant — it is a causal factor. If some one need is not sufficient to cause certain objects to become dominant, punishment may then serve a useful office. And so may reward.

Punishment and reward must accordingly be regarded as meaningful characteristics of situations which contribute causally to satisfaction. By way of illustration, we may note that an energy source (stimulus) in a given situation may remain wholly unchanged and that the *need* for food may remain unchanged or possibly increase; but when the meaning of harm appears in connection with food being eaten, an individual may instantly cease to eat. Man accordingly responds to meaningful objects — not to stimuli — as sources of satisfaction. When the observed properties of such objects change, behavior also changes. The object may no longer be satisfying.

Any theory of trial-and-error learning that is broad enough to look at learning in this manner is valuable. But we cannot accept this theory in so far as it stresses the gradual establishment of precise neural bonds between stimuli on the one hand and specific bodily responses on the other hand. We find no reason to hold that in learning the *response* is made mechanically to *particular* stimuli and not to the situation as a source of satisfaction. To be specific, food may possibly be in a distant part of an observed situation; the finding of it gives significance to the whole situation. Under repetition with accompanying satisfaction, the organism constantly shifts its patterns. We can accept no theory which holds the act itself must be specific to the stimulus. In this connection, we again point to Lashley's results with his rats. We know, moreover, that in a particular situation the rat or dog may *run* up at one time and *walk* up at another, it may approach satisfaction now from one side and now from another, it may push at a barrier to satisfaction now with one paw and now with another. The specificity of organic response that should be logically expected in terms of a constant set of "stimuli" cannot be found. Such changes in behavior repeatedly appear to a striking degree as an animal becomes less hungry (where hunger has been the motive or need). The animal may break suddenly into playful activities. The objects which were formerly reacted to in order to secure one sort of satisfaction are now reacted to in order to secure another sort of satisfaction. And we must necessarily assume that they are observed differently under the two situations.

d. Situational or Field Theory. We are unable to accept the theories of conditioning and of trial-and-error learning as being wholly adequate. Yet it must be understood that, viewed broadly,

each theory does good service in certain situations. In many other situations, however, their value is less significant. We cannot agree, for instance, that the learning which issues in the case of understanding (and there are so many of these) can be adequately considered under either theory. We must recognize that man may change functionally without the necessity of many repetitions and that, measured in terms of the products which appear from time to time, such changes may persist over long periods. Man readily understands in many situations without any random searching or any gradual elimination of errors such as commonly features trial-and-error-learning. One may also understand without any substitution of an "artificial stimulus" (sight of food) in place of a "natural stimulus" (taste of food) in accordance with the theory of the conditioned reflex (salivation).

The student will do well to recognize that man always responds, as far as action is concerned, to the observed properties of things — the thing may be himself or something else. There is always a situation which demands that something be done. The individual is sustained by his need, desire, interest, purpose, or intention. The functional outcome in the beginning may not be adequately satisfying in terms of situational demand. The need or purpose accordingly persists (reappears) and the organism continues its efforts. Success comes and the situation changes — it may, for instance, become more restricted and directive. Items which stand in the way of satisfaction tend to drop away as particular objects become dominant — when they definitely assume new properties in terms of a particular end-result. Man does not respond psychologically, therefore, to stimuli, either *present* or *temporally* absent. He observes meaningful characteristics of situations; and he acts with respect to them. Changes occur both in these properties and in the way in which he acts with respect to them. Where such changes are due directly to man's functioning — not to disease, drugs, brain destruction, old age, fatigue, increase in age, and other like conditions — we call them learned.

Observation of meaningful properties is basic to each theory of learning — conditioned reflex, trial-and-error or situational. We find no reason to assume that any animal, for example a dog, can observe physical and chemical energy. And we know how very readily a change in an observed situation, where the physical and chemical stimuli remain wholly unchanged, may result in a change

in behavior. Moreover, no psychological situation at the human level can be shown to be composed of meaningless elements added to each other. There is always a meaning *common* to the whole. Moreover, any arbitrarily abstracted part of the total situation may possibly carry this same common meaning. We walk down a dark street (at night). We are afraid of robbers. We see a foot extending from behind a tree. We certainly do not react to a *foot* as just a foot, but as the foot of a man. The same is true of his hand or head. A "cue," we accordingly say, is simply an observed thing which carries a particular situational meaning. The "whole" thus affects each "part." A cue, therefore, is not a reduced stimulus, nor an independent thing, nor a senseless fragment of a situation. It is something observed; it is meaningful.

We assume that learning consists in facing a situation and discovering in various functional ways therein some particular source or form of satisfaction (dissatisfaction); something which fits into the individual's pattern of needs. He may accordingly *perceive* (and so learn about) objects which satisfy him. Or, he may *act* in certain ways toward objects and, by so doing, derive satisfaction. Moreover, he may *imagine* a situation; and it may be so pleasing that he dwells upon it again and again. Furthermore, he may *think out* the solution to a situation and thereby learn for the first time about its relational properties. In each case, an individual functions because of some reason which may belong primarily either to his hereditary equipment or to his personal history. In the first case, for instance, he may discover a new kind of food that greatly pleases him; in the second case, he may learn a new way of luring insects to his laboratory.

Any adequate theory of learning must necessarily provide for specificity which shall apply not to some stimulus but to an end-result. It must also provide for functional stability but with a maximum degree of modifiability. The stability must be considered, however, in terms of permanent *sources* of satisfaction and not in terms of immutable behavior patterns. We know quite well that man and animal may cling tenaciously to a source (object) of satisfaction under conditions which force a rapid shift in the actual behavior patterns whereby the satisfaction is obtained (consider a food or sex object). An adequate theory cannot be mechanical in the sense that it fails to provide a place for situational meanings as a major agent in determining man's activities. It

must fully recognize that meaning is a psychological product of man which definitely affects the course of his activities during every moment of his life. Such a theory must also provide for the various changes which occur under repetition; yet reject *repetition itself* as being a causal factor. Furthermore, it must find ample room for the importance of observation — since we know at first hand the part which it plays in our own lives in the selection, isolation, elimination, substitution, and addition of relevant items. Finally, it must fully recognize the significant rôle which inherent factors play in furnishing the basic conditions of all functional changes. It must regard heredity's most significant contribution to learning to be a brain which is so constituted that it functions continuously and so endowed that it directly produces meaningful situations and relates them to each other.

e. Brain Functions. We assume the brain to be laid down as a form of hereditary equipment and that its inherent functional properties are of paramount importance in learning. Yet we are able to say very little of a factual nature about it. We assume that the brain functions as a unit and not in parts — each functionally isolated and independent. We assume that no one part is necessary for such functional properties as perceiving, imagining, or thinking. It follows, therefore, that no one part is absolutely necessary for learning. Energy, we hold, can be shifted over and around the brain areas in an enormously large number of directions to enable the organism to act effectively in a large number of ways with respect to some end. We again point, in this connection, to the experimental results of Lashley's studies. In one study, for instance, he destroyed a portion of the right hemisphere of a monkey's brain, thereby causing its left arm to be *paralyzed.* He then trained the monkey to secure food by working the door of a box with its right arm. Then he removed a portion of the left lobe, thus paralyzing the right arm. The left arm, previously paralyzed, had now recovered. Although this arm had never been *trained* in this situation and although it was paralyzed during the actual training period of the right arm, there was almost perfect transfer to the left arm. The animal could work the box. There was, in this case, a definite need and there was the direct observation of a familiar situation in terms of a mode of satisfaction. The energy shifted over the brain to produce the end-result. The situational outcome was very important; but precise movements of particular

muscles were not. An adequate theory of learning would hold, therefore, that man always functions with respect to situations; that he perceives, imagines, reasons, and acts with respect to situations. And, in each case, he does so in terms of a common meaning. Back of the total observed situation stands the total brain, functioning as a whole. Such integrated functioning permits us to envisage learning as being much broader than we can get from a picture of brain functions in terms of simple bonds or reflex arc pathways.

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OUTLINE

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CHAPTER XVIII

INDIVIDUAL DIFFERENCES

A. *Introduction*

A most striking form of evidence concerning the subtle interrelation of causal factors is to be found in the field of individual differences. Of the vast number of organisms belonging to some one species, no two individuals have ever been shown to be identical. To differ seems, therefore, to be one universal rule of nature which allows no exceptions. Similarities exist, it is true; but causation seemingly stops short at producing complete identity. The various determining factors which fall under the general classes of heredity, training, and environment work ceaselessly at their task of turning out unlike products. It remains then for man to seek an understanding of those variations which are particularly significant for science and life. Regardless of the life level, human or subhuman, man must understand an individual organism in terms of its major properties with respect to particular situations in order to deal effectively with it. The trainer and the sportsman, for example, clearly recognize this truth as it relates to the animal organism; while the physician, the industrialist, the lawyer, the penologist, and the scientist make similar acknowledgment at the human level. As far as understanding is concerned, there is no average individual — regardless of the particular nature of the characteristic — anatomical, physiological, or psychological — which may be considered at any given moment. No physician or psychologist, for instance, ever attempts to deal directly with an average individual. Each clearly realizes that an adequate understanding can come only through considering a particular individual in terms of his relations to his own stock, his own personal training, and his environment.

Man has always been guided in the major affairs of life by his recognition of individual differences. Selective mating, even at the most primitive level, definitely implies discrimination. Moreover,

the acceptance of a particular chief or leader by a savage tribe or by a civilized group rests upon an acknowledgment of differences. For ages, however, the recognition was essentially practical or aesthetic. No serious attempt was apparently made before the 19th century to examine and to quantify in a strictly scientific manner the various forms of outstanding differences existing among human beings. Galton was a pioneer in this particular field; he was the first to attempt a careful statistical examination of man's dissimilarities. His methods, broadened and improved, find wide employment today. The earlier studies in this field were directed largely at certain differences to be found in imagination, memory, perception (color preferences), and action (reaction tests). Galton, for example, sought to reveal the exact psychological tools used by men in different types of creative work such as music and invention. Many individuals were studied and divided into different *types* on the basis of the particular nature of their mental imagery. Such so-called types — visual, auditory, motor — no longer possess the significance which they originally enjoyed; for it is now recognized that men usually create without any observable imagery. Galton himself discovered that outstanding scientists, for example, repeatedly reported either little or no imagery. Many who reported it seemingly recognized it to be an imaginational accompaniment, which apparently made no contribution to the end-result. But Galton's methods have since been continued in other directions. The vast amount of work which is now being done on intelligence may be regarded as representing but a single illustration. Of the various ways in which human beings differ psychologically, one of the most striking concerns intelligence. We turn now to consider this topic.

B. *Intelligence*

a. Its Nature. Let us be partly guided here in our understanding by what we have previously said concerning the nature of learning. Like learning, intelligence is neither a process nor a function; it is not a part of a human mind, a mental thing, a force or an active agent. Simply speaking, it is one *phase* of man's psychological functions and their several products. It merely concerns one aspect of what man does at times under certain conditions. It directly involves the nature of the functional products which appear in particular situations. Thus, certain functional

products are commonly regarded as being intelligent; but others are not. In every case, the particular situation (task) makes them either intelligent or non-intelligent. Man's intelligence is accordingly revealed by what he does, observes, speaks, or writes. No individual has ever observed intelligence as a form of cause or determining factor standing back of behavior. Man merely observes meaningful situations or objects; he notes that something is different or changed; he observes various psychological properties of things. Since Binet developed the first intelligence test, it has always been assumed by critical students that such tools actually measure what is done by an individual under certain conditions; that is, they do not *directly* measure heredity, training, or intelligence. Man can unquestionably measure functional product. He cannot, however, measure intelligence as something distinct from psychological function. We say "psychological," for intelligence, as is true of learning, definitely concerns meaningful things — not physiological phenomena.

1. *Definitions.* A brief examination of the many definitions of intelligence should materially aid the student in understanding our particular approach to this topic. Intelligence commonly implies the ability to act effectively in new situations, to understand, to realize (evaluate) consequences of acts, to learn, to imagine various features of some possible situation, to grasp relationships among things, and to order behavior in accordance with imagination and thinking. In this connection, we note the position of Terman, who developed the most widely used form of the Binet test (the Stanford-Revision) and who has probably done more in this general field than any other individual. An individual, he holds, is intelligent in so far as he is able to think. He points out in part that it is the race which excels in abstract thinking which eats when conditions are hard, which survives epidemics, which substitutes science for taboos and justice for revenge. Any given society is ruled, led, or molded "by the five or ten per cent of its members whose behavior is governed by ideas." Intelligent behavior does not concern the speed with which one can react to a shock or to a blow on the knee. It is recognized that certain physiological functions of the feeble-minded are quite as efficient as those of a genius. Reflexive behavior of the subnormal may be as rapid as that of the superior individual (*I.Q.*, 119). On the whole, it deals less with situations involving purely perceiving and acting and more

with situations demanding understanding and thinking. Under these particular conditions, as we have said, important relational properties emerge. An intelligent person is one who is able to see through complex situations which clearly baffle an unintelligent individual. If there were no persons who were unintelligent, there would be no intelligent individuals. The term is wholly relative. The more intelligent is able to "create" new characteristics to a greater extent than is the less intelligent. The former can accordingly find more common meanings in life situations; and he is more able to transfer his knowledge about one thing to some other thing.

2. *The Matter of Learning.* We must also glance hurriedly at a definition of intelligence in terms of learning. When this is confined to particular situations, it unquestionably has considerable significance. But indiscriminate use dulls its value; nothing is gained by using learning synonymously with intelligence. The white rat can learn a maze as quickly as a graduate student. The same holds for a child. But we are not willing to suggest that the rat is as intelligent as man. That is, unless we thereby wish to destroy whatever value the concept of intelligence or whatever use the intelligence test has in life affairs. As we have earlier said, maze scores actually are recognized as showing no significance when correlated with intelligence. Let us be properly guided, therefore, in our thinking. Intelligence demands recognition in psychology. But its value should not be impaired by making it do *service on all* occasions.

3. *Function — Not Structure.* Since intelligence is simply a phase of psychological function and thereby concerns what is done upon specified tasks or within definite situations, it should be evident that it is significantly independent of glands, muscles, height, size, weight, skin color, social status, and religion. Since there is no relation, for instance, between such characteristics and understanding or thinking, there is, therefore, no relation between them and intelligence. Moreover, there is no observable bodily sign or indication of such functional traits as thinking; nor is there of intelligence. There is, for instance, no particular head bump which may be felt in order to determine an individual's ability to understand. It is accordingly difficult within limits to determine the degree of intelligence of an individual from an examination of his structure and his gross behavior patterns. Except among

the lower degrees of feeble-mindedness, the accuracy of such judgments is possibly equal to that of chance expectation; the superior individual is not physically marked as in the case of the idiot.

4. *Brain Products*. Intelligence apparently involves neural — not muscular and glandular functions. It concerns brain, not brawn. The brain functions under certain conditions and particular meaningful products emerge. Regarded from one angle, these psychological products are intelligent. Intelligence, therefore, is what the brain does. By way of illustration, we can say that a measure of functional products here is similar to a measure of products in digestion. The nature of digestion is commonly determined, for instance, by the physiological chemist by examining *sample* products taken at definite intervals (or under definite conditions). The nature of intelligence can be determined only by taking samples of the functional products which emerge within definitely controlled situations. We are forced to hold, therefore, that intelligence is not *something* which lies back of something else, any more than *digestion* is something which lies back of a continuous sequence of determinable changes occurring within a situation involving (1) a stomach, (2) glandular products, and (3) a certain amount and kind of food.

b. Development of Intelligence Tests. 1. *Various Forms*. The intelligence of human beings can be determined by various methods. There are psychological, social, economic, and educational ways. If an individual, for instance, does not maintain himself at a desirable level under a particular set of conditions or if he does not learn in school, he may be regarded as being intellectually deficient. It is naturally understood, of course, that a feeble-minded girl may possibly be self-maintaining, economically speaking; but the particular mode may be socially undesirable. All social and economic failures are not due to a lack of intelligence; nor are all cases of school failures. As we shall show, many have no relation to intelligence. A child may be regarded as being normal until it enters school. Then it may begin to fall behind in promotions. Unable to succeed, it may cause serious trouble. The particular *nature* of the demands of the situation actually works here to reveal feeble-mindedness. Had the individual always faced much less exacting situations, its life course would have run differently. It may now be brought into court where, upon examination, it may be committed to an institution. Now, this examination will

normally involve the use of intelligence tests. By these means, the individual will be directly compared, in terms of his ability to perform upon standardized tasks, with many other individuals of his own particular age. If his score falls below a certain level, he will be regarded as being feeble-minded. Intelligence, psychologically viewed, concerns the nature of the score obtained in a given situation involving specific tasks. Let us consider how these test-tasks have been developed.

2. *The Binet Tests.* Binet was asked by the French government to devise a reliable method of separating those individuals who were capable of profiting from formal training from those lacking such capability — in short, to separate more intelligent from less intelligent. He finally (1905) arranged a series of 30 simple tasks to test "general intelligence." Binet definitely assumed that these several tasks were such as to demand the use of imagination, judgment, and reasoning. Binet's major contribution concerned, therefore, (1) the particular type of functional demand — what the tested individual was supposed to do in the testing situation. Men had earlier worked upon problems of individual differences; but they had stressed such problems as the accuracy of perception or the speed of action (reaction tests). Binet, however, stressed such functions as imagination and understanding. His tasks were accordingly more difficult and more complex. They were, moreover, (2) more varied; they provided a wider or larger *sampling.* Upon a fuller realization of this point, Binet later enlarged his "test" so as to include 54 simple situations or tasks. These tasks were arranged in order of their increasing difficulty and complexity.

(a) *A scale and a mental age.* From his use of his tests and his recognition of the fact that ability gradually increases with age, he was led to arrange the tasks into different age levels including the years from three to thirteen. His method was straight-forward. He simply tried out many unlike tasks upon a number of children of various ages. When most individuals of a given calendar age could perform a task too difficult for most of those below that age and too easy for most above that age, it was accepted. For example, since about 75 per cent of the seven-year individuals could determine the value of six coins, it became a part of the seven-year test. As a phase of his testing program, Binet developed the term "mental age." That is to say, the child who passed the 4-your tests and failed in the next year had a mental age

of 4 years, even though his calendar or chronological age might have been six. Or, he might have had a chronological age of 4 years; yet if he passed the 6-year tests, he had a mental age of 6.

(b) *Two age levels.* In order that the student may have a more adequate understanding of the nature of these tasks we give a few from two age levels. The normal three-year-old is supposed to be able to give his last name and sex, to point to his nose and eyes, and recognize (name) a knife and a watch. A normal eight-year-old is supposed to be able to count backward from 20 to one, to tell the procedure for finding a ball lost in a circular field, and to indicate how two objects, such as a peach and an apple, are alike. Each age level, as worked out by Binet, laid certain functional demands upon the individual. The way in which the child met them determined his mental age.

(c) *The intelligence quotient.* The significant value of the mental age as a way of expressing mathematically the particular level of psychological development attained by an individual at any given moment should be clearly realized. It provided, in short, a simple method of indicating growth levels. Psychologically speaking, each child could now be given a definite place with respect to many others. It definitely quantified each individual's amount of psychological growth. A child might thus be 4 or 5 or 13 years old. It did not, however, describe an individual either with respect to the actual rate of his psychological growth — his brightness, or with respect to his emotional traits. Of the second, nothing has been done as far as the Binet test is concerned. The forms in use today do not touch emotional development. It is accordingly recognized that the six-year-old child with a mental age of six is very different from the sixteen-year-old boy with a mental age of six; the attitudes and needs of the second are significantly different. Of the first, however, something has been done. The rate of intelligent growth is now expressed through the use of the intelligence quotient. This method was originally suggested by Stern; and mainly developed in this country by Terman. The method simply relates mental age (*M.A.*) with chronological age (*C.A.*) to show how rapidly (slowly) an individual has developed psychologically. Whenever the two ages are the same (e.g., 7 and 7), the intelligence quotient (*I.Q.*) is always 100. Whenever the *I.Q.* is greater than 100, the *M.A.* is always greater than the *C.A.*, and whenever the *I.Q.* is less than 100, the *M.A.* is less than the *C.A.* If a boy,

for example, has a calendar age of 6 and a mental age of 4, his *I.Q.* (brightness) may be obtained by dividing the latter (4) by the former (6). We get here an *I.Q.* of 66; the *M.A.* is less than the *C.A.* If these two ages were reversed, we would get an *I.Q.* of 150.

(d) *Stanford-Revision.* In addition to developing the use of the *I.Q.*, Terman has also revised the Binet test and made it the most useful of all tests of its sort. In so doing he used large numbers of subjects in order to obtain reliable age norms at each level. He also decreased the difficulty of some age levels and at the same time increased the number of sample tasks to 90. The total test now provides for adults, both average and superior. The age limit has accordingly been advanced from Binet's original 13 to include the upper limits of intellectual growth. Some results of the test obtained from a large unselected group of children from five to fourteen years of age are shown graphically in Fig. 111. The various intelligence quotients are arranged along the base line here and the individuals are properly arranged above each of these in terms of their respective *I.Q.*'s. There are a few (5 per cent) who fall below 75 (*I.Q.*) and a few (5 per cent) who fall above 125 (*I.Q.*). The test actually seems to work as an intelligence test should; that is, it seemingly does what it is supposed to do, *namely*, separate the dull and the bright individual to be found in an unselected group in such a way as to conform to a normal frequency (bell-shaped) curve as shown in this figure. If the scores of a given test, which is taken by a large number of individuals selected by chance, do not distribute in this normal manner, it has little value.

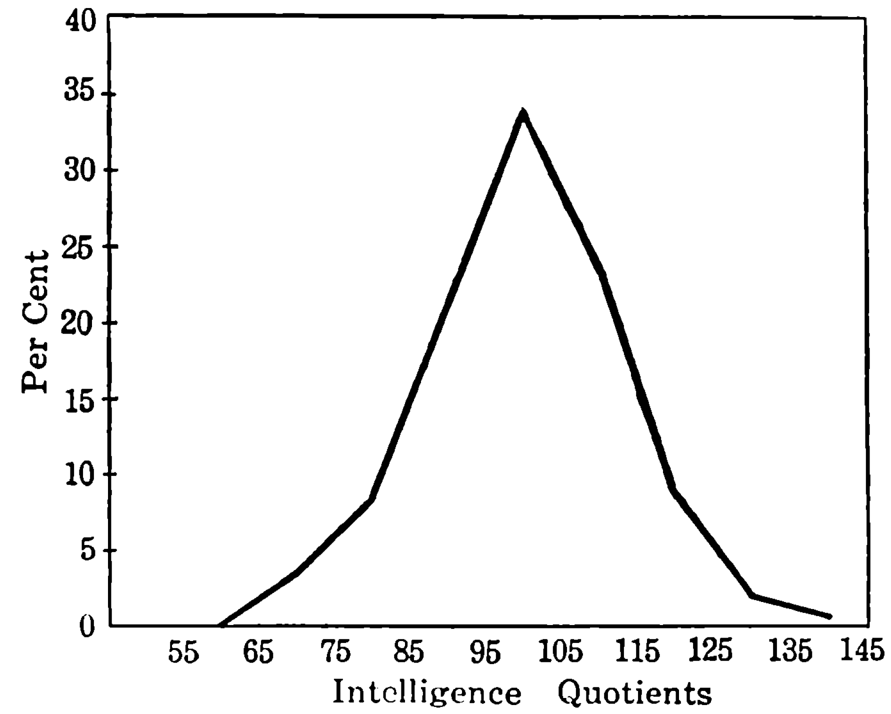

FIG. 111. A fairly symmetrical distribution. Some are inferior and others are superior.

c. Intelligence Testing in the World War. 1. *Development of Army Alpha and Beta.* The intelligence testing movement received great impetus when this country entered the World War. The great desire for increased efficiency led to the formulation of a testing program which was nation-wide in scope. Before the war

ended, around two million men from all parts of the country had been given intelligence tests. For this purpose, two tests were constructed by psychologists. The one was the Army Alpha and the other was the Army Beta. The former involves the ability to read, but the latter does not. The *Beta* was accordingly used with the illiterate and with the foreign-born soldiers. In constructing these tests, adequate recognition was given to such factors as keeping the tasks free from school training, requiring a minimum (or no) degree of writing, selecting the tasks so as to have some sufficiently easy for the dull and some sufficiently difficult for the bright, and arranging the tasks so as to permit rapid and impersonal grading. The psychologists were also concerned with the problem of being sure the test actually worked as it was supposed to, which is really a matter of validity. Validity is commonly determined by comparing a test with something else, e.g., another test or school grades. And they sought to make it reliable — a feature which is commonly determined by correlating some one part of the test with another part or by giving the test twice to the same group and checking upon the two sets of scores. If there is little change between the first and second sets, the test is reliable.

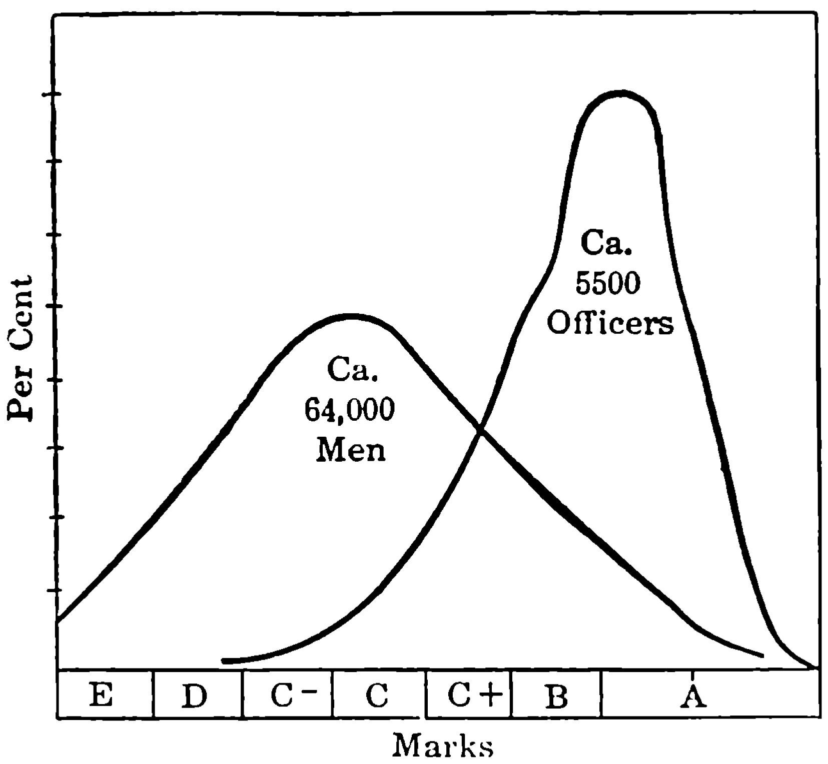

Fig. 112. Were all officers superior to all enlisted men?

2. *What Army Tests Supposedly Test.* The Army Alpha is not one test; it is really a set of eight subtests, which are supposed to test (1) ability to reason out simple problems or to draw conclusions or to grasp relationships, (2) ability to understand directions or to rearrange words so as to give some common meaning, (3) knowledge of synonyms and antonyms, and (4) general information. Under (1) the individual may be asked to solve problems in arithmetic or to tell why one thing is better than another; under (2) he may be told to place a cross in the lower right corner of one square and in the upper left corner of another, or he may be required to change words as in the following illustration so as to

make a sentence of: book red me the hand; under (3) he may be asked to indicate whether the second word of a pair, such as *beneath* — *above*, has the same or opposite meaning; and finally in (4) the individual may be asked to classify (identify) things, that is, to state for instance whether sorghum is a plant or a drug or a kind of rubber.

As a direct result of the tests some eight thousand men were recommended for complete discharge while as many were found to be fit solely for labor. A small number were selected for more intellectual tasks of which some were placed in special training schools for officers. Figure 112 shows the distribution in terms of letter grades of almost seventy thousand men, including some 5,500 officers. This distribution shows that many men actually did better than many officers, or that some officers fell toward the lower end of the distribution for the enlisted men. On the whole, however, the officers did much better than the men. The modes of the two groups fall fairly far apart.

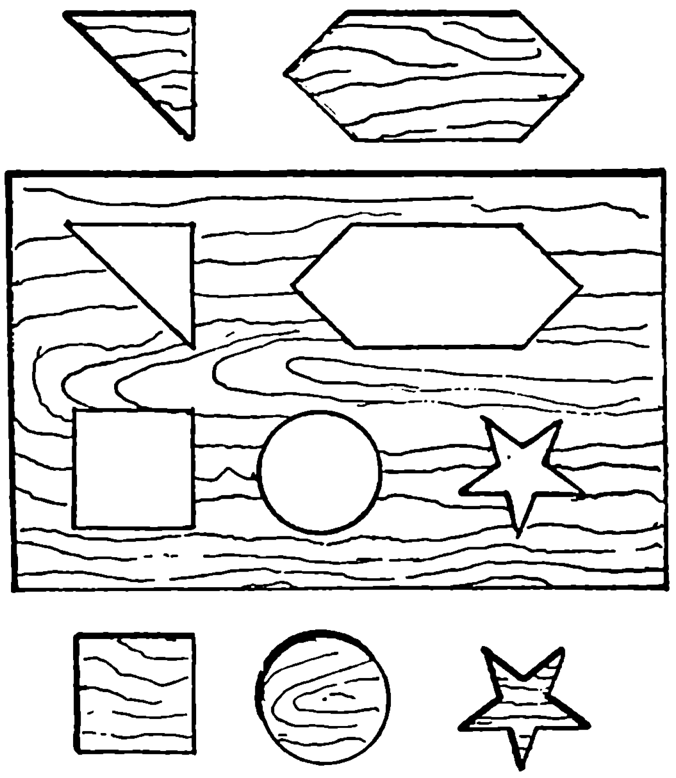

Fig. 113. Form board.

d. General Types of Intelligence Tests in Common Use. Two gross divisions may be found in the kinds of intelligence tests in use today. The one (1) kind is designed largely for childhood and early adolescence. Running through these are the concepts of mental age, the amount of development, and the intelligence quotient (which furnishes a measure of the rate of intellectual development). The various revisions of the Binet tests are commonly used here. Other tests are also employed some of which do not involve language. These may be used for various ages. The child may be asked (a) to place objects into properly shaped holes (form board as shown in Fig. 113), or (b) to put pieces of pictures together, so as to produce an object, or (c) to draw pictures of environmental objects. In tests (a) and (b), the amount of time taken to complete the task and the number of errors made are commonly used as measures. In the picture drawing (c), completeness of the various parts of the object drawn and the relationship among the parts serve as the

basis for determining different age norms. Figure 114 shows some results obtained from different age levels with the use of the form board. This tool is more effective for testing *younger* children.

Using various bases, growth norms have been established for ages as early as 4 months. Dependence is placed here upon such patterns as smiling, noticing large objects, turning head toward speaker, or holding head erect while being carried. At 12 months, for instance, the child will walk when helped, will speak two words in addition to *dada* and *mama*, will keep a cube in each hand and take a third, and will hold cup while drinking. The other (2) kind is designed particularly for group work with mature individuals. Less emphasis is placed here upon the notion of development. The test score of an individual is commonly interpreted in terms of the performances (scores) of other individuals upon the same tasks. The various scores are usually arranged in the form of the ordinary distribution curve in order to furnish a comparative basis.

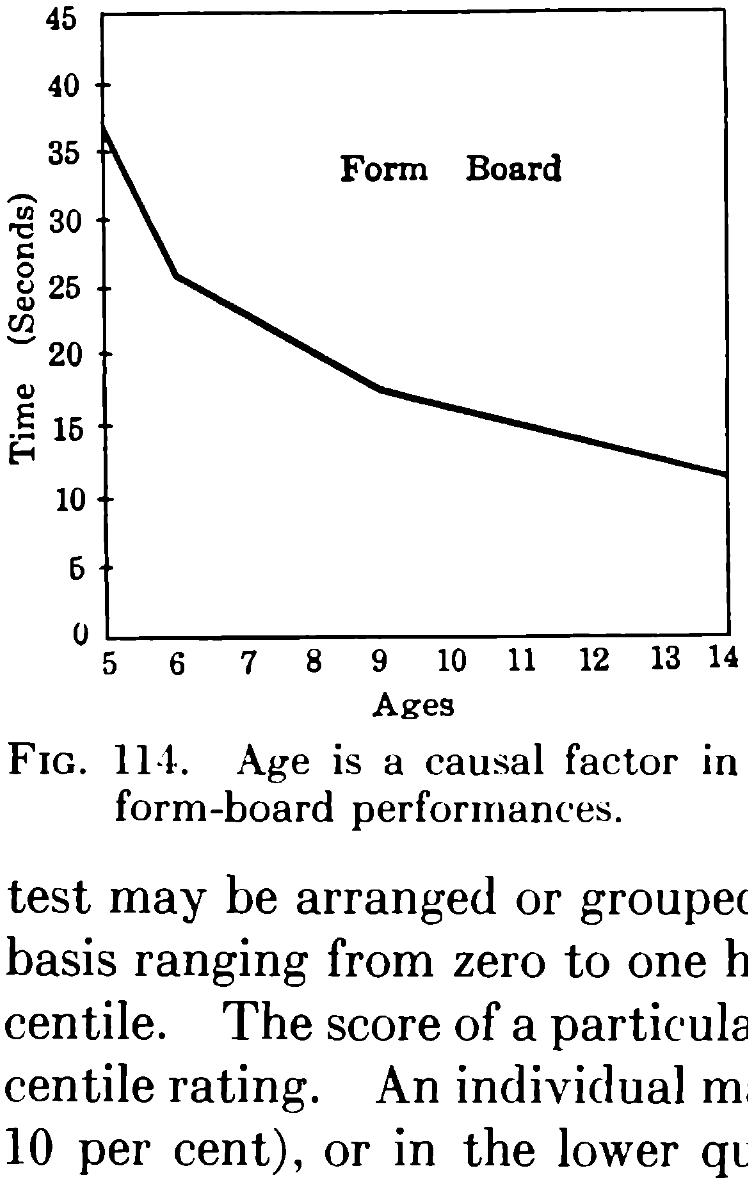

FIG. 114. Age is a causal factor in form-board performances.

e. Statistical Comparison. The various scores obtained from a test may be arranged or grouped from least to greatest upon some basis ranging from zero to one hundred. Each step is known as a centile. The score of a particular individual can be given a definite centile rating. An individual may stand in the upper decile (upper 10 per cent), or in the lower quartile (lower 25 per cent). Some universities, for instance, will not accept as a student one who comes from this latter division of his total high school distribution. The individual may also be compared in terms of median value of his group. The median represents the particular value on either side of which one half of the cases fall (50 centile). Or, he may be placed with respect to the mean or average value, which is to be found by dividing the sum of all scores by the total number of cases.

Correlation. An important aspect of the general problem of individual differences concerns the degree of relation existing between any two functional characteristics as revealed by achieve-

ment. Science often seeks to relate the degree of achievement shown on one task to the degree manifested on another task. It is interested in discovering, for example, the probable extent to which the rate at which individuals read is related to their degree of understanding, or to what degree success in pre-medic courses in the biological sciences is related to success in a medical college. Does high achievement in one academic field, as measured by grades, justify expectations of similar achievement in other fields? The method of correlation is useful in such determinations. By means of the coefficient of correlation, science is able to give mathematical expression to certain functional relations. The coefficient may range from + 1.00 through .00 to − 1.00. If an individual who stands highest on one task also stands highest on another task, and if another individual stands second on both tasks, etc., we say there is perfect positive correlation (+ 1.00) (see Fig. 115). High achievement in one field means high achievement in another field. The various causal factors which determine the products in the one case, also operate in the second case. On the other hand, if the highest individual on one task is the lowest on the other task and the next highest on the one task is next lowest on the other task, we would have a perfect negative relation (— 1.00). Perfect correlation implies, therefore, that a great deal of one ability presumably goes with either a great deal (positive) or a very little (negative) amount of another. If there were no relation between achievement on one task and achievement on another task, the coefficient of correlation would be zero (.00). That is, a small amount of one ability might be accompanied either by a great deal or by very little of another sort. As a matter of fact, perfect correlations and zero correlations are rarely obtained. A coefficient ranging around .50 is commonly acceptable as being significant, one around .35 is not so significant, while one around .15 has little value.

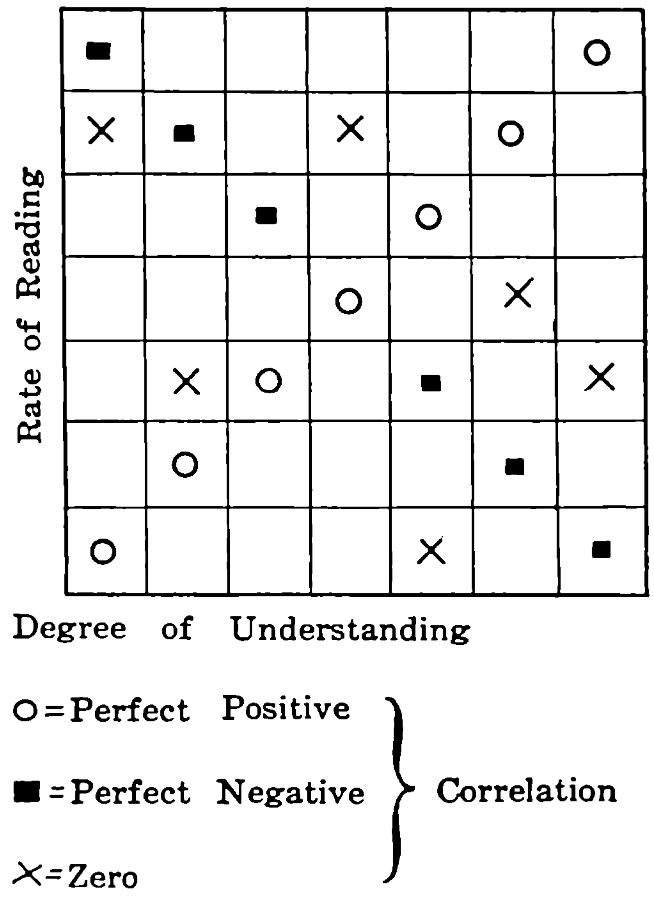

Fig. 115. Diagram showing three possible types of relationship between two abilities.

To understand one method of correlation and to indicate one coefficient, let us glance briefly at the results obtained from a group of college students who were tested with respect to speed of reading and possession of vocabulary. Two standard tests (Minnesota Reading Tests) were given to all individuals. On the one task, they were asked to read as rapidly as possible with full understanding. On the other test, they were asked to indicate correct synonyms. The raw scores on the first test are arranged (speed column) from highest to lowest in Table III. Each is properly ranked here. The scores on the vocabulary test are also placed

TABLE III

Subject		Vocab. Score	Speed Rank	Vocab. Rank	d	d^2
1 M W	30	57	1.5	5	3.5	12.25
2 R C	30	68	1.5	1	.5	.25
3 T M	29	57	3	5	2.	4.
4 B E	27	10	4	11.5	7.5	56.25
5 V R	26	41	5	10	5.	25.
6 M Y	25	57	6	5	1.	1.
7 C M	24	39	7	13	6.	36.
8 A N	21	58	8.5	3	5.5	30.25
9 D B	21	45	8.5	9	.5	.25
10 M M	19	54	10.5	7	3.5	12.25
11 B B	19	63	10.5	2	8.5	72.25
12 N A	18	10	12.5	11.5	1.	1.
13 G C	18	34	12.5	14	1.5	2.25
14 J R	16	29	14	15	1.	1.
15 C N	15	46	15.5	8	7.5	56.25
16 V H	15	27	15.5	16	.5	.25
				Sum of d^2 =		310.50

(vocabulary column) after the individuals' names and given a proper rank. The *difference* (d) *between the two ranks* is shown together with their squares (d^2). This sum of these squares is used in the following formula to secure a coefficient of correlation expressing the relation (as in this situation) between speed of reading and vocabulary ability. The formula used in the method of correlation by *rank differences* is $\rho = 1 - \frac{6\,\Sigma\, d^2}{N(N^2 - 1)}$. The symbol ρ stands for the correlation obtained by this method of rank differences; Σ represents the *sum* of the differences (d) after being squared; and

N indicates the number of individuals (16 in this case). The formula, with the numerical value of the d^2 and of the cases properly substituted, reads as follows: $\rho = 1 - \frac{6(310.5)}{16(16^2 - 1)} = + .55$. As measured under these conditions there is a correlation of + 55 between speed of reading and vocabulary.

f. Distribution of Intelligence. Men are certainly not born equal as far as intelligence is concerned. There are striking functional differences of a psychological sort, just as there are functional differences of a physiological sort. Particular families may show a surprisingly large number of inferior individuals when measured in terms of the number of individual members committed to institutions for defectives. Other families, however, are significantly free of such commitments. The ranks of the feeble-minded represent one form of heredity's contribution to the human stock. Nature may be said to take away with one hand, as in the case of inferior, and to give with the other, as in the case of superior individuals. The feeble-minded may be roughly compared to an imperfect gem which may continue, regardless of the amount of polishing, to show the same defect. We may work long and intensively with a feeble-minded person; yet when we have finished, an idiot may remain. Such training, like the polishing of a gem, merely reveals more clearly the inherently determined defect.

As we have said, the psychological measure of intelligence is represented by the score made on an intelligence test. Considered in terms of intelligence quotients based upon test achievement, individuals have been divided into the several classes shown in Table IV. The theoretical percentage of the total population is placed at the left side.

TABLE IV

1%	*I. Q.*	140 up	genius
5%	*I. Q.*	120 to 139	very superior
14%	*I. Q.*	110 to 119	superior
60%	*I. Q.*	90 to 109	normal
14%	*I. Q.*	80 to 89	dull
5%	*I. Q.*	70 to 79	very dull
1%	*I. Q.*	50 to 69	moron
	I. Q.	20 to 49	imbecile
	I. Q.	0 to 19	idiot

The lower three levels below 70 (*I.Q.*) include the feeble-minded. Such individuals range without apparent break from high-grade morons (or very dull individuals) to vegetative idiots. The moron may or may not require institutionalization. If he is emotionally stable, he may encounter little trouble in maintaining himself in society. He may possibly manage to get through the lower grades of the grammar school. Unless deliberately promoted to prevent undesirable emotional effects from arising through school retardation, he has small chance of reaching the upper grades. His mental age gradually falls behind his calendar age. Physically and psychologically speaking, he grows just as steadily as do normal individuals; but at a rate so slow that by the time he reaches sixteen, for instance, he usually has a mental age of around eight (to eleven) years. Figure 116 shows the comparative rates of development of a superior individual (A), a normal individual (B), and an inferior individual (C).[1] The imbecile seldom reaches the grammar school. Psychological development is so slow here that, by school age, the individual may be unable to talk. When properly supervised, the imbecile may possibly do ordinary manual tasks around the house or the farm. The idiot, however, is fairly hopeless. An adult with a mental age of two or three years may be unable to talk or to use a knife and fork. Such human beings have the gross bodily structures common to the species; but, functionally regarded, they are lower than many animals. They perceive surprisingly little; and their action patterns are extremely simple. There is very little evidence of memory and imagination; and understanding is chiefly confined to simple commands such as one might use with a higher animal, These cases of functional equipment are to be contrasted with those to be found at the upper end of the total distribution of the

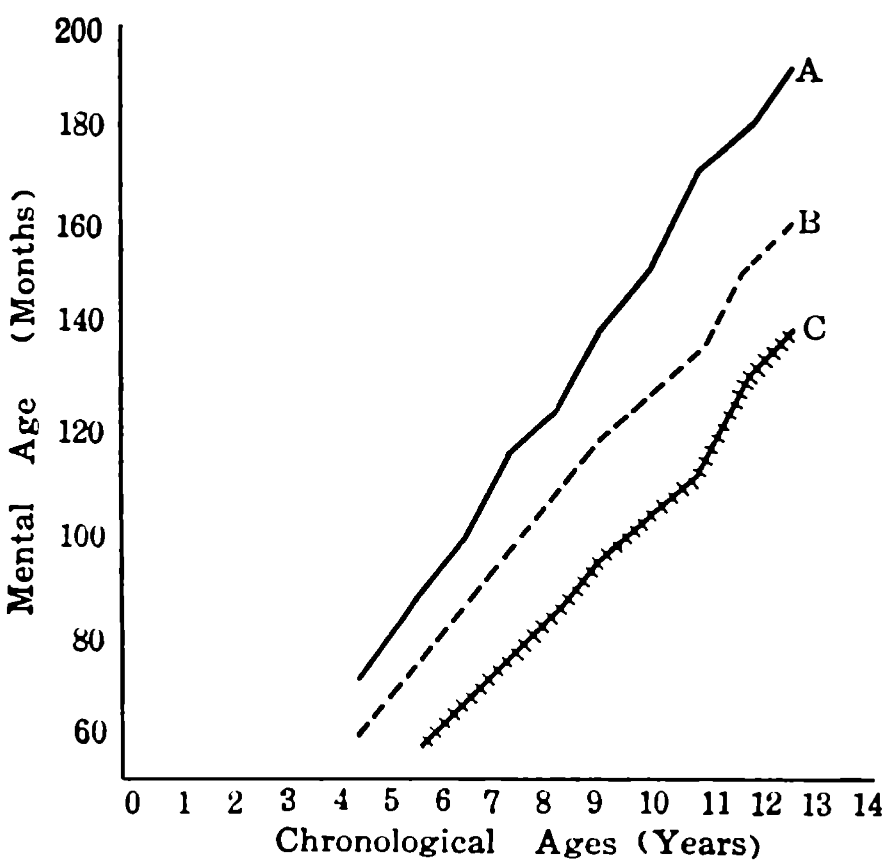

FIG. 116. Psychological growth curves.

[1] C is partly theoretical: A and B are modified from Baldwin and Stecher.

population. Not infrequently these latter individuals may be doing creative work of a valuable nature when most normal individuals are playing with dolls or riding tricycles, and before some feeble-minded are actually walking, dressing, or feeding themselves.

g. Changes in Intelligence with Age. We have previously seen that functional development as revealed by studies on learning ability at various age levels seemingly increases until man reaches his late 'teens (18–20). In a similar way, we can say that functional development, considered in terms of intelligence and measured by standardized tests, apparently shows similar growth limits. The older notion that functional development, as concerned in intelli-

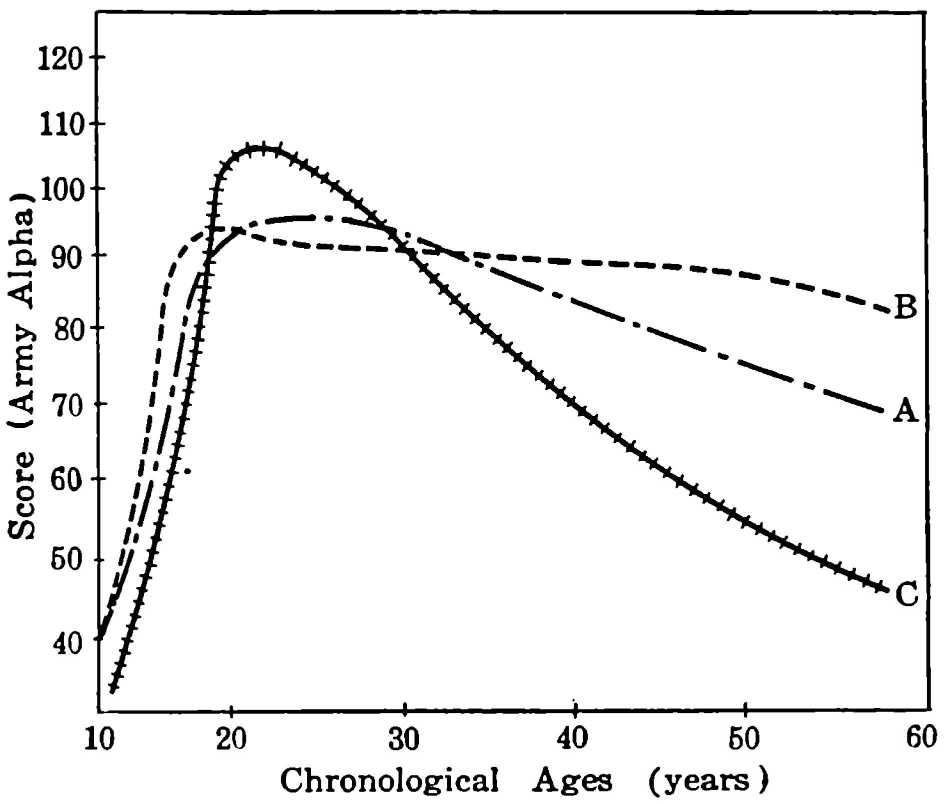

FIG. 117. What effect does age have upon intelligence test scores?

gence, stops around fourteen years is no longer held. Terman, for instance, has shown a range in *M.A.* from 13 to 19 years, with an average of 16, in a group of business men and students. Miles has concluded from careful studies upon unselected groups of different age levels, that intellectual development proceeds at least to 18 years. Thorndike has advanced evidence which indicates that growth occurs up to the senior year in high school, which would give an age of 17 to 18 years. Figure 117 shows the differences in scores on the Army Alpha among various age groups from 10 to 60 years (Jones and Conrad). This figure is based upon extensive data obtained from rural and village populations in New England. As many as 90 per cent of the testable population of certain communities were examined. We find here that at 55 (*A*), an individual stands at the 14th year. The loss up to that time is not very

great. Curve *B* shows results of testing groups who had congregated at halls to see motion pictures. *C* shows results obtained by testing subjects in their homes. These differences indicate how selective factors may work. The older defectives could be found and tested only by visiting their homes; for they were not inclined to attend shows.

The results of these studies again reveal to a striking degree a significant truth about intelligence. There is, for instance, no decline as measured by some parts of the Army Alpha (opposites and general information). But there is some decline as measured by other parts, for example, those concerned with analogies and broken sentences. In some tests, the adults clearly surpass adolescent; in other tests, the superiority is reversed. Striking differences among localities also appear. The *remote* rural groups did not do as well as the village and near village populations. Illustrative data are given in Table V. (*R.R.* represents remote rural, *V* stands for village, and *M* stands for average score.) In every case, the remote group falls below the other group. The cause here is understandable; it is selective. The remote groups have been affected by a difference in the migration rate of the superior and the inferior. A large number of the latter stay on the farm.

TABLE V

Age Group	Alpha	
	V *M*	*R.R.* *M*
10	48	18
13	60	55
15	88	84
18	117	95
19–21	117	83
25–29	82	70
35–39	87	70
45–49	79	41
55–59	76	52

Figure 118 shows the size of the *I.Q.*'s for individuals of different ages and of different educational levels (Miles). Each group shows about the same rate of decline. Moreover, the three levels are surprisingly distinct with no overlapping at any point. Some

effects of age upon maze performance and accuracy of judgments are shown in Fig. 119. From what has been said, it should be understood that age affects individuals quite differently with respect to their psychological abilities. Some men very early in life start to decline, while other men may maintain themselves until very old age at a remarkably high level. Chief Justice Holmes who recently died at 95 was seemingly as efficient, as far as understanding and reasoning were concerned, at the time of his retirement as he was during his most productive years. Miles, for example, reports that as many as 25 per cent of his *oldest* individuals were as good as or better than the general adult level.

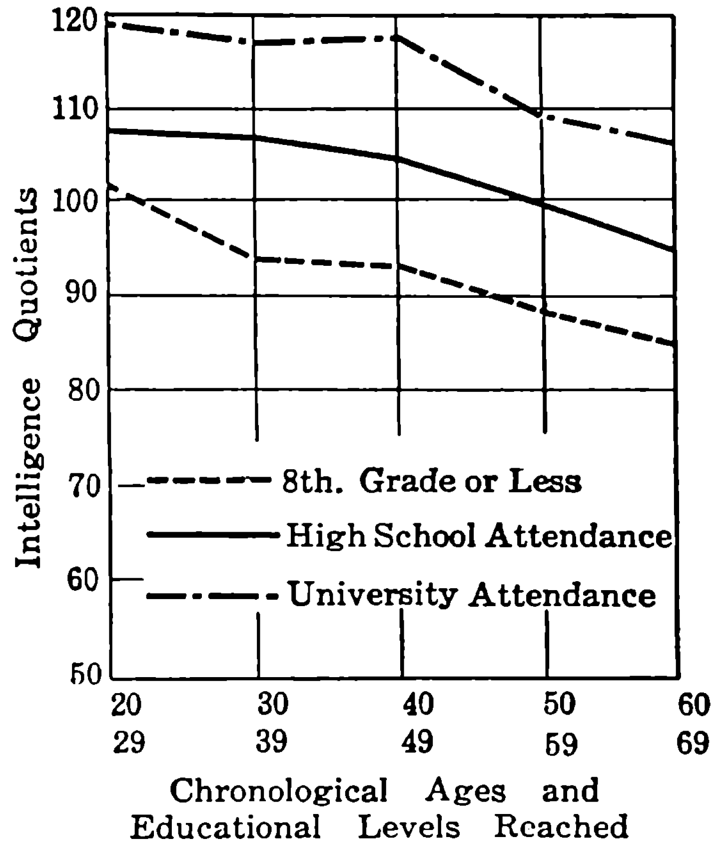

Fig. 118. Do these three educational groups decline at similar rates?

h. Constancy of the *I.Q.* The intelligence quotient expresses the rate of functional development as measured by standardized intelligence tests. As the chronological ages of individuals increase, so do their mental ages (up to certain limits). The rate may be fast, slow, or medium; but it is, nevertheless, fairly uniform. The feeble-minded grow slowly; the brilliant grow rapidly. In each case, the rate is apparently determined to a major degree in the hereditary constitution of the particular individual. Some children are clearly precocious. Others are subnormal. Galton, for example, was able to show from his elaborate studies of superior individuals, that intellectual excellence shows itself very early; it tends, moreover, to persist throughout life. Man is so innately

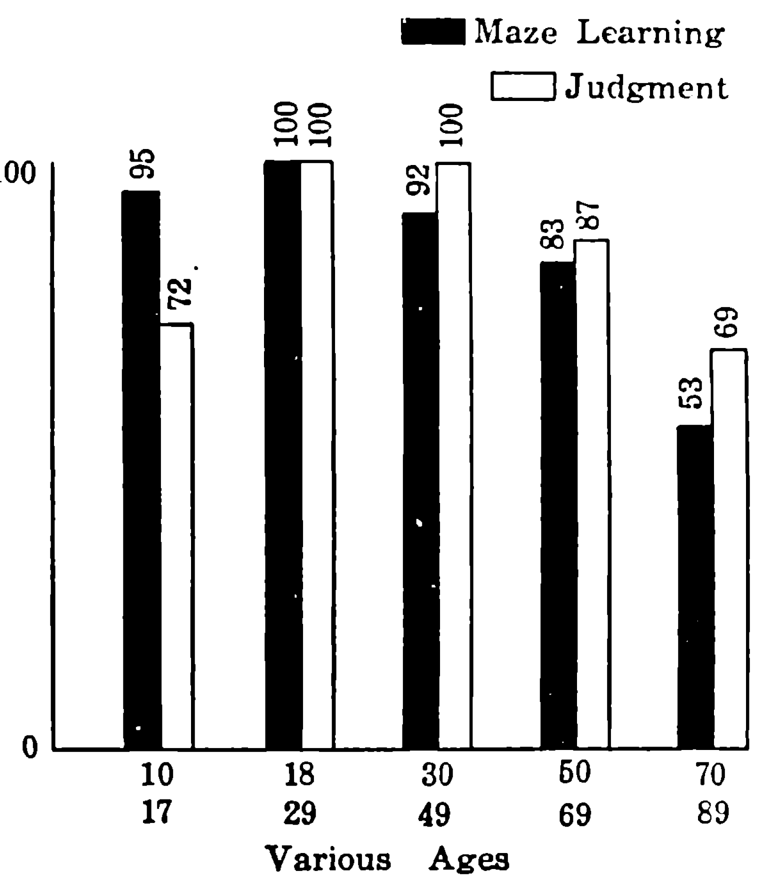

Fig. 119. Does old age greatly impair judgment as measured here?

endowed that his development, both physical and psychological, runs on at a pace independent of his own personal choosing. Furthermore, it does not go by spurts. Uniformity of pace is seemingly as much determined as rate of development. What a child reveals today in terms of its *I.Q.*, when obtained under proper conditions, it tends to reveal later. That is, the feeble-minded continue to be subnormal, the average remain normal, and the superior continue to excel. We do not place the feeble-minded into institutions in the expectation that they will be released in six months as normal individuals. As a matter of fact, children of two and three years of age are frequently given "life sentences" in an institution for the feeble-minded.

Generally speaking, uniformity is the rule, and variation is the exception. This fundamental principle runs throughout life. Man's physiological functions, for instance, develop uniformly. He can run faster, hit harder, and digest more at eighteen than at eight. Possible variations in achievement when standardized intelligence tests are retaken do not necessarily imply a lack of uniformity in functional development. There are many causal factors in each situation which determine the nature of particular functional products. Worry, fear, illness, fatigue, indifference, or antagonism on the part of the subject, or bruskness, carelessness, changes in instruction, or other conditions on the part of the examiner may result in some variation. Often it can be shown, where variations in *I.Q.* occur when individuals are retested, that the second tests were given under different conditions involving the time of day, nature of distracting objects, changes in attitudes, and new examiners. Generally speaking, wide changes in *I.Q.* should be attributed to the particular *test situation* and not to sudden spurts or rapid losses in intelligence. Finally, we must frankly assume that many tests are actually inadequate. This is especially true of the types used at very early age levels (less than 3 years).

i. Amount to Change. Tests which are repeated with groups of children past five years of age may possibly reveal an average increase or a decrease of as much as five points in the *I.Q.* level. Terman, for example, has reported that his studies indicate that the *middle* 50 per cent of changes in some groups might fall within the limits of 3.3 decrease and 5.7 increase. In 1930, after a period of six years, he retested a group of superior individuals. In 54 cases, the *I.Q.* showed an average drop of 9 points. In general,

most individuals stood at the earlier tested level. Another student checked 300 school children six different times over a period of six years. In 58 per cent of the cases, yearly variations were almost non-existent. In another 37 per cent, the yearly variation was not large enough to affect any predictive value. In about 5 per cent, the yearly variation was 10 points or more (Hirsch).

When children belonging to the pre-language period are tested and then later retested, large changes often appear; a shift of 10 points or more may occur. The child tested at 6 months and retested at 2 years may give significantly different results. The dull may become brighter, or the bright may become duller. Such results issue in part from the inherent difficulty of securing the coöperation upon situational tasks necessary in order to secure acceptable results. They are due in part to difficulty of formulating suitable tasks for such levels. All tasks, as we have said, are not adequate; some have very little bearing upon intelligence. To measure its intelligence, we must be able to lay particular demands upon the child's understanding. The speed of reactions and other simple behavior patterns possess no significance. Possible sensory defects which may increase the difficulty of testing may remain undiscovered for some time in the young child. Partial deafness or blindness may not be revealed until the child is two years old. Operations which remove sensory or structural defects may possibly result in an increase in *I.Q.*

Under certain conditions, test scores may undoubtedly improve, just as they may decline. Too often at the expense of understanding, students tend to emphasize the rise but neglect the fall. If some devitalizing condition, such as may be induced by hookworm infection, is removed, improvement in the psychological functions may follow.[1] It is always assumed, therefore, that all situational conditions must be "fair," if an acceptable measure and an *I.Q.* which possesses predictive value is to be secured. Where it is evident that the physical condition of a subject is temporarily impaired, the test results have no predictive value for normal individuals. We must recognize, therefore, that intelligence can be known only in terms of what is done under particular conditions

[1] But we must recognize that significant increases seldom appear following improvement in physical condition. The student is referred here to the work of Lowe and of Rogers on adenoids and diseased tonsils, of De Weerdt on malnutrition, and of Fox on glandular changes. Results here show surprisingly small changes in *I.Q.*

or situations. A significant variation in any *causal* factor must necessarily have its effects. Generally speaking, the high degree of constancy actually found throughout life is quite understandable if viewed sensibly. The simple facts that morons are not readily made by favorable "environments" into normal individuals or that precocious children are not easily reduced to either mediocrity or subnormality by unfavorable "environments" should be *instructive.* It hints at the existence of an important stabilizing agency that orders (1) the rate, (2) the uniformity, and (3) the amount of development from birth to death. Functional consistency is normally expected. When lacking, it actually excites our concern. We directly suspect some unusual condition. Functional consistency, we suggest, arises directly out of man's inherent constitution; it is an inseparable aspect of his very protoplasm. If such determination admittedly stands as a basic condition of intelligence, we should similarly expect it to affect other phases of life. By recognizing that intelligence and its stability actually concern man's functional properties, we are materially aided in evaluating these fundamental characteristics of man in terms of inherent determination.

j. Significance of Intelligence. 1. *Relation to School Achievements.* It is universally recognized that some children succeed in school where others fail. Some move ahead so much more rapidly than others that they may finish the elementary school two or three years earlier than the average do. We may accordingly inquire concerning the nature of the relation between scholastic success and achievement on intelligence tests. To what extent do school marks correlate with high test scores? Burt, for instance, reports a correlation of + .91 between school work and Binet scores of children who ranged from ages of seven to fourteen. Maller, who conducted a wide survey of fifth grade children in New York City, found a correlation of + .70 to hold for 275 different sections between intelligence and school progress — a coefficient which is considerably higher than some have found under other conditions. Gates, for instance, reports the following relations between *I.Q.* (Binet) and educational achievement test scores for different grades: Grade I, + .36; grade III, + .47; and grade VI, + .67.

When students enter high school, the significance of intelligence as a factor in possible success or failure definitely declines. That is, it is less important than in the grammar school. The

decidedly inferior individuals have been eliminated. By dropping the stragglers, the group advancing into high school becomes more alike. Other factors also play a more dominant rôle — some contribute and some detract. Participation in athletics, falling in love, desire for social approval, and determination of occupation with emphasis upon certain courses with possible indifference toward other subjects play a part. The weaker individuals may possibly be given good grades because of non-scholastic reasons, and the good students may shift their interests away from the classroom. It is not surprising, therefore, to find the correlation between intelligence and grades to fall as low as +.28 (5,700 students). Other investigators have reported coefficients of + .40, .55, and .60. With the same intelligence tests, the results vary widely with different groups; scholastic standards (grading and promotions) are by no means identical. Even in the same city, large variations in this respect may occur among different high schools. Some teachers will give high grades to "weak" students (as determined by intelligence tests) while other instructors are more searching and less liberal. Many administrators contend that it is more desirable, under such conditions, to base college entrance upon intelligence test scores than upon high school marks. The test score properly used is probably the most valuable single device at the command of the school administrator.

It is recognized that the correlation between achievement in college and intelligence test scores is generally less than that of the high school. The college unquestionably receives a selected group, when the students are measured in terms of their scholastic success in high schools. The high school failure does not go on to college. There are, however, other non-intellectual factors operating at the college level. The average correlation between *I.Q.* and college success, as measured by grades, will possibly run, therefore, some 10 points below that of the high school. Depending upon the particular school and the particular test, coefficients range from around + .20 to + .65. A study reported from Ohio State University, for instance, revealed a relation of + .45 between intelligence test and scholarship.

2. *Value of Tests at College Level.* The value of intelligence tests at the college level necessarily has its limitations. If a student is failing, despite hard work and strong motivation, tests may possibly indicate an inherent inadequacy for college work. In many cases

of failure, however, tests actually show high *I.Q.'s*. The determining factor, therefore, lies elsewhere. The value of the test methods should be clear. When in doubt (and there are many such cases), use may be made of them; they furnish one method of diagnosis. Generally speaking, the major ills of the average college student cannot be intellectual, since most of them have sufficient intelligence to do satisfactory work. This is occasionally shown in cases of identical twins, one of whom may be an honor student while the other may be dropped for poor work. College groups, as is true of all highly selected groups, are fairly homogeneous. It is a bit disturbing, therefore, to consider that about five-sevenths of those who enter our colleges fail to graduate. The mortality rate is exceedingly high. Of 1,958 freshmen entering a large midwestern university a few years ago, a check at the end of four years revealed only 18 per cent in the graduating class. Of the several selective factors which work at elimination, intelligence plays a minor rôle. Colleges do not need a higher level of student intelligence in order to secure desirable scholastic achievement; they actually need a different pattern of causal factors of a non-intellectual sort. In order for more students to secure greater profit from college attendance, the students themselves must create a different situation. Their purposes, goals, standards, and ideals must necessarily change. We unhesitatingly assume that a slight change in purpose or motivation with intelligence remaining constant would materially lift the whole level of scholastic achievement.

3. *The Relation of Intelligence to Occupational Levels.* (a) *Some distributions.* Within definite limits, intelligence seemingly plays a part in determining occupation. Individuals with *I.Q.'s* of 80 have many fields closed to them. Their barriers are unscalable. But where the degree of intelligence is high, as in case of two honor graduates of a recognized medical school, one may be a success and the other may be a failure. Other determining factors operate here. Intelligence may possibly be necessary in order to meet certain definite occupational demands; but non-intelligent factors also play important parts. The army tests contributed a great deal of valuable data upon the intelligence level of many occupations. In certain cases, many thousands of individuals falling within one line of activity were tested. In so far as the results may be trusted, we have a striking cross-sectional picture of many occupations as represented by individuals from many parts of the country.

Within the upper 12 per cent, based upon the tests, fall such groups as engineers, physicians, teachers, lawyers, and executives. In the next 15 per cent, come the stenographers, photographers, and skilled tradesmen. The farmers, police, printers, and tailors fall in the next lower 25 per cent. In the last 41 per cent come the barbers, laborers, firemen, and store clerks. Figure 120 gives a comparative picture of various occupations regarded in terms of the raw scores made on the Army Alpha. Some possibly representative *I.Q.'s* of other types of activities are as follows: (not from *Alpha*) students (college), 109; business men, 102; firemen and police, 84; and salesgirls, 85.

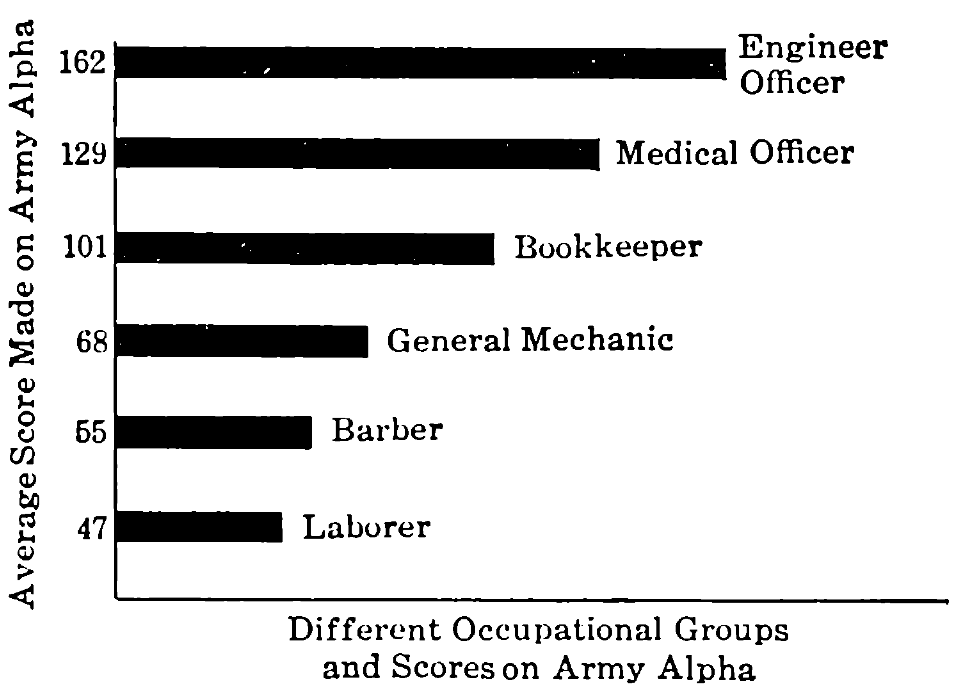

FIG. 120. Do occupational demands furnish an adequate explanation of these differences?

(b) *Children and parental occupation.* It would appear that a fundamental selective agency plays a significant part in determining occupational *level.* That is, whether one becomes a professional man or a day laborer is not purely a "matter of chance." We speak here in terms of large numbers — not of individual cases. The particular factors, however, are extremely difficult to disentangle. But we might say, for example, that the bright boy becomes determined not to waste himself as a farmer or laborer. The dull boy, however, is satisfied to go along from day to day; he does not aim very high. We do not assume that the number of intelligent boys who remain on the farm is as large as the number who leave it to enter the professions and industry. The careful studies of rural and village populations in New England point in this direction. The more remote rural sections are seemingly drained of a significant percentage of superior stock. Higher

intelligence here (farm) presumably causes dissatisfaction and restlessness. If we grant the operation of a selective factor, we can also understand the intelligence level of the children of men in different occupations. Figure 121 shows the average *I.Q.* of *pre-school*

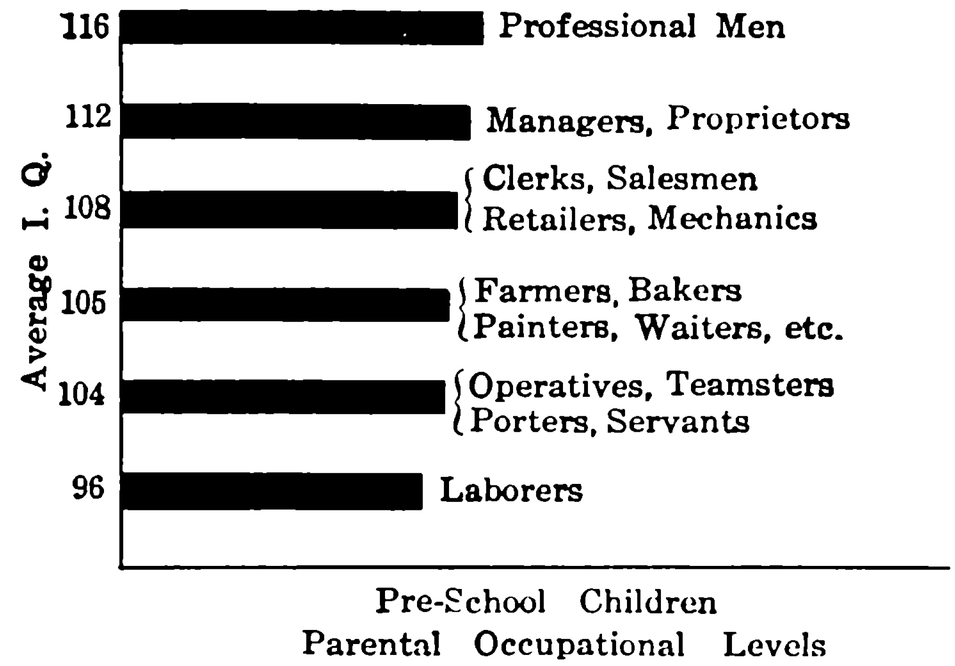

FIG. 121. We may attribute such differences in part to the operation of rigorous selective factors.

children of parents from different levels (Goodenough). Figure 122 gives a comparative picture of the average *I.Q.'s* of children of *school* age of parents from different occupational levels (Jordan). If we may legitimately assume that the parents of these children were, in general, segregated at various occupational levels by particular and widely operating selective factors, we can better understand the differences in the performances of their children upon intelligence tests. It may appear that a meager environment might serve as a major causal factor here. But even the pre-school children clearly differentiate themselves. To produce such early changes, an environment would necessarily have to be more effective than most men would admit in view of other types of evidence. It would accordingly appear that the various hereditary factors which contribute directly to the intelligence and indirectly to the occupation of the parent, also contribute to the intelligence of the child. Heredity, we suggest, indirectly affects occupational level.

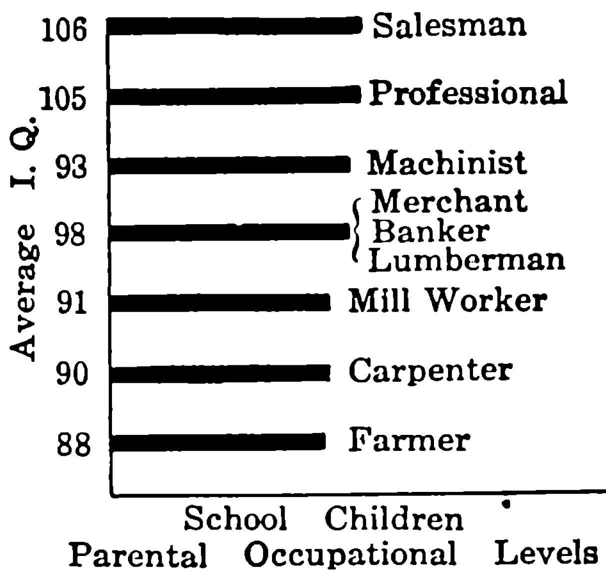

FIG. 122. Is the intelligence level of school children related to parental occupation?

4. *Intelligence, Delinquency, and Crime.* That a feeble-minded individual faces a greater probability of becoming a delinquent or a criminal is universally recognized. When it is evident that an individual and a social group must be protected, the defective is commonly institutionalized. Feeble-mindedness itself does not produce delinquency. It is not a direct cause of anything. Neither does heredity directly serve in this manner. If an individual, however, is so lacking in understanding that he cannot realize the difference between right and wrong, he is more easily misled. If an individual should strongly desire a particular satisfying object, yet lack sufficient imagination to envisage the possible consequences of certain actions, he may get into serious trouble. The same holds true if he is unable to order his behavior in accordance with the social group in which he is placed. Hereditary contributions to delinquency and crime are accordingly indirect. If an individual is not properly equipped, both physically and psychologically, to meet life, he must suffer. This is strikingly true at the subhuman level. Every hunter knows how rarely he ever meets crippled and diseased animals. The feeble-minded may have too little of some functional characteristics. Or, they may have too much, as in the case of strong emotion, in comparison with their understanding, imagination, and thinking. The balance is always relative. In a wide survey of fifth-grade children in New York City, Maller found a correlation of − .60 between intelligence and juvenile delinquency.

A significantly large percentage of delinquents and criminals have been shown to be functionally subnormal, when measured by intelligence tests. Out of several thousand cases of repeated juvenile offenders, Healy[1] found about 13 per cent to be deficient in this respect. Perhaps as many as 25 per cent of all inmates of various reformatories may be feeble-minded. They properly belong in a school for defectives, but not in a reformatory. Such individuals are never reformed, except by placing them under constant protective (restraining) conditions. To try to reform them is quite similar to trying to reform an individual who is born with weak eyes. It may be that a like proportion of defectives is to be found in our institutions for the more serious offenders. According to some students, prostitution also draws heavily from the class of defective girls. Perhaps 15 to 25 per cent of them

[1] Head of Judge Baker Foundation (Boston).

would come under this classification. This factor partly depends, however, upon economic conditions. Under very great stress, more individuals turn in this direction, as was strikingly true in Europe during the post-war crises. As a rule, however, we must recognize that emotional factors are always dominant in prostitution. Evidence indicates that prostitutes are, on the whole, more docile and more easily influenced than a like number of other individuals. We suggest that it is this docility or lack of resistance which contributes more often than feeble-mindedness to their station. It would appear that no reliable evidence has ever shown as many as 50 per cent of all such groups to be feeble-minded.

The serious crimes, particularly those of murder, have even less to do with intelligence. Most of them arise directly out of emotion. Wensley, who for many years was Inspector for Scotland Yard, points out that most of the murders which occurred during his period were crimes of passion. It is an interesting fact that decade after decade, England's murder rate remains almost constant. Within the last month, the Metropolitan Company has published the results of a national (U S.) study of homicides. This report reveals that the average age of the murderer is about thirty years (+ 5 or − 5 years) and that he is without *previous* criminal record. This should clearly remove him from the class of feeble-minded. It is, in fact, quite too long for such individuals to go without getting into trouble. From the court proceedings, it appears that the average murderer is neither feeble-minded nor discoverably defective in other ways. Moreover, this "average" murderer killed on "the spur of the moment" he was carried away by strong emotions. In this connection we recall a striking statement attributed to Hill, who is head of the Eastern Federal Penitentiary, to the effect that, generally speaking, the best trusty can be drawn from the ranks of the murderer.

5. *Relation of Intelligence to Some Personality Traits.* Students have diligently searched for reliable evidence bearing upon the possible relation between intelligence on the one hand and honesty, or humor, or moodiness on the other hand. Many have found a lack of correlation between scores on intelligence tests and scores on personality tests (inventories). There is seemingly no relation between sense of humor and degree of intelligence (within limits). The same apparently holds for honesty. One may be able to understand or to think efficiently, regardless of his honesty or dishonesty.

We find no reason to believe that *goodness* (honesty) is inherently determined. The possibility of being satisfied, however, is a form of hereditary equipment. That which satisfies may be good and that which does not satisfy may be bad. There is neither goodness nor badness in nature. Moreover, it is neither good logic nor psychology to assume that the ability to think should necessarily lead to social conformity. In fact, it is the thinker who is most likely under particular conditions to question the value of such conformity. Our reformers are, as a rule, individuals who have thoughtfully considered situations in terms of desirable changes.

C. *Heredity and Individual Differences*

a. Does Training Itself Improve a Function? We recognize that men show great functional differences. Some cannot see or hear (perceive); some cannot understand or think. Other men show a remarkable degree of each. We have definitely assumed that, in a way, each psychological function is determined through heredity. We have held, moreover, that training itself does not actually "improve" man's ability to understand or think. Now that the student has thoughtfully reviewed some of the facts about intelligence, the significance of our approach should be more apparent. Intelligence, of any degree of significance, unquestionably involves the ability to understand and think. Every sensible definition places particular emphasis upon these functions. It is clearly recognized, furthermore, that as yet no one, irrespective of theory, has ever developed an effective method of training the feeble-minded or the dull so as to increase their intelligence. This implies that it is impossible, in other than those ways which we have previously discussed in the chapters on thinking, to train individuals to think. If through very intensive training a subnormal individual could finally be made to face (create) and solve thought-situations, we could better understand that his intelligence had been changed. We have not assumed in any sense that intelligence is "something" which is separate and distinct from psychological function. We find no reason to assume that a man can fully understand and think under various life situations, yet at the same time be feeble-minded. There are certain sources of evidence which bear indirectly upon the matter of hereditary and environmental factors in intelligence. We shall now consider them.

Let us make clear that we do not intend to enter here into a detailed discussion of the relative importance of heredity and environment. We assume that each organism continuously "creates" its environment and that the basic functional foundation of such creation is laid down in the original germ plasm, regardless of any changes that may possibly have been induced through life activities.

b. Correlation Studies. To what extent, let us ask, are the various offspring of two parental stocks or strains alike? It has repeatedly been shown, for instance, that ordinary *physical* structures of two brothers show a correlation around + .50. That is, such characteristics as height, eye-color, and shape of head are seemingly related to this extent. But two wholly unrelated men (picked at random) show an average correlation in these respects of .00. Many studies upon various *psychological* characteristics of two brothers (two sisters) give coefficients of correlations ranging from + .40 to + .60 with an average of + .50. Thus we may see that the psychological side of man is seemingly as much determined in these particular cases, as revealed by the use of psychological tests given at maturity, as his ordinary physical traits are. But physical traits are commonly assumed to be *fairly independent of particular environmental influences.*

A number of years ago, Thorndike tested various psychological characteristics of fifty pairs of twins and secured correlations ranging from + .69 to + .90. Since then, many studies have been made on this general problem. Merriam, for instance, found that all twins when tested gave correlations of + .84. Upon analyzing his data with respect to sex, he discovered that twins of like sex gave + .90, while those of different sex gave + .70. The latter individuals must always have come from *two* different eggs which were fertilized approximately at the same time. The constitution of one egg, however, could possibly vary to a considerable degree from the other — at least, two different sexes could be produced. The hereditary factors in these cases were probably more different than in the case of like sex. Some of these same-sex twins possibly came from a single egg, just as the Dionne quintuplets can be supposed to have come originally from the separation of a single egg into several parts. Heredity, in all cases involving just one egg, is probably very similar. Hence a correlation of + .90 was found in the one-sex twins as against + .70 for the two-sex twins. It is

understandable that identical twins who come from one egg and fraternal twins who come from two eggs should show striking differences when measured by intelligence tests.

c. **Co-Twin Control.** In 1930, Hirsch tested 58 pairs of *fraternal* twins and obtained a correlation of + .53 which should be compared for purposes of understanding with + .50 obtained from ordinary siblings (brothers and sisters). He also checked identical and fraternal twins under similar and dissimilar "environments." The identical individuals living under grossly similar environments gave a difference in *I.Q.* of 2.3 points; under dissimilar environments, he obtained a difference of 3.5. Fraternal twins living under "similar" conditions gave a difference in *I.Q.* of 13. His results were complicated by the fact that some of his identical subjects had not been separated very long, or had separated after having lived together for several years. These test results should also be considered in connection with the interesting data obtained by Muller and by Newman. Ten pairs of identical twins, who were separated when quite young, gave a difference in *I.Q.* of 8.6 points. The difference here is about equal to the average changes occurring within the group reported by Terman where the middle 50 per cent of the changes occurring between earlier and later testing of the same individuals falls between 3.3 and 5.7 points (*I.Q.*). Fifty *identical* twins who had been reared together were also tested, giving a difference of 5.3 points (*I.Q.*). To be compared with these identical twins, are fifty pairs of fraternal twins who had been reared apart. They differed by 9.9 points (*I.Q.*). It would accordingly appear that identical twins reared apart may be as different as fraternal twins (ordinary brother and sister) also reared apart (8.6 points for ten identicals mentioned above).

We do not assume that the same sex in cases of twinning actually makes the "environment" more alike, thereby producing psychological similarity. Individuals, of course, create their own environments. The degree of likeness in intelligence depends primarily upon inherent likeness. Environment, we assume, is never constant either for the same individual, over any prolonged period, or for any two individuals. Heredity itself is not absolutely constant, even in case of identical twins. It is, however, the major determining factor of the similarities. The Dionne quintuplets, for instance, have faced the same temperature, lighting, food, and handling. Yet with this striking similarity (greatest ever known), individual

differences of a psychological and biological sort such as could well be due to inherent conditions are apparent.

An interesting study of the co-twin control type was made by Gesell and Thompson with the use of the training method. One twin (46 weeks old) was trained for six weeks upon situations involving chair climbing. At the end of this period, the other twin (52 weeks) was trained for two weeks upon the same tasks. The first twin was rather helpless at first and needed assistance. After four weeks' training, she moved rapidly along without assistance. At the end she required 26 seconds for the climbing task. The other twin, without training, climbed the staircase in 45 seconds. Two weeks' training reduced this time to 10 seconds. The first twin was trained over a period three times longer than that of the second twin, yet at the end it required a period $2\frac{1}{2}$ times longer than the second in order to complete the task. The experimenters were led to conclude that practice and exercise do not contribute to the appearance of patterns as are involved in such tasks. The orderly process of organic development apparently provides for the appearance of such patterns. The individual moves along its determined course of growth as the neural substratum of behavior elaborates. A few weeks of increased age, as in this case, more than compensates for any effect of training. Nature seemingly equipped the untrained twin, during the period in which its sister was receiving intensive training, so that when its turn came, it was enabled to move steadily ahead and at a faster pace.

d. Sex Differences. Generally speaking, girls do better in school from the first grade on through college as measured in terms of the relative number of each sex eliminated and by the nature of the grades received. They are consistently superior in certain subjects, especially those involving language and writing. Although they clearly surpass their brothers in scholastic endeavors, yet when the doors of college close behind them, the men are the ones who forge steadily ahead. Here is, indeed, a most puzzling shift, the adequate answer to which remains to be given. College training has been provided for girls in this country for over a century, yet the relative number who achieve distinction in non-scholastic fields is strikingly small. Of the facts, we are sure. But, of the interpretation, we are uncertain. A possible difference in emotion may serve as a contributory factor; a possible difference in motive or interest or purpose may also account for the differences

between the sexes in terms of non-scholastic achievement; or, a possible difference in biological and social opportunity might serve as a causal factor. Even in the field of literature, where little physical strength is required and a *nom-de-plume* is quite available, few women ever achieve eminence.

The superiority of the girls during part of their school period may possibly be attributed to a possible difference in functional development due to greater maturity, even when their chronological ages are identical with those of the opposite sex. Whipple, for instance, reports some data upon several thousand cases which indicate that girls have a mental age which exceeds by seven months the age of boys (like *C.A.*). Terman, moreover, has reported girls to be slightly, although consistently, superior (in terms of *I.Q.*) up to adolescence (14 years), at which period the boys forge ahead. Here again we assume that fundamental hereditary factors must operate to produce functional differences. Significant differences also appear between the sexes when considered in terms of achievement upon various parts of the Binet test (Stanford Revision). Boys excel in such tasks as arithmetical reasoning, finding similarities, and reversing the hands of a clock. The girls are superior in comparing and drawing memorial objects, in aesthetic comparisons, and in rhyming. The sexes accordingly vary in their functional products with *particular situations*. If we think of intelligence as being *some one thing*, there are no sex differences. If we regard it as being a term which may be applied to any one of a variety of different functional activities out of which different products emerge in each case, we can say that there are specific differences. If such possible differences are able to account for the recognized superiority of the girl in scholastic fields, they may be regarded as being significant. In short, it seems that reliable sex differences on specific tasks unquestionably exist. But when the results from many tests are thrown indiscriminately together, in much the same manner that many data are often thrown together in one smooth learning curve, no significant differences appear.

D. *Environment and Individual Differences*

a. Occupational Levels. Interesting data have been secured, concerning the unlike performances of certain economic and cultural groups upon intelligence tests. Gordon, for instance, compared children of canal boat families. Such individuals receive

almost no formalized training; their lives are very narrowly limited; and their social contacts are confined chiefly to the various members of their own family. Until old enough to migrate, the children of these families live rather isolated lives under barren intellectual conditions. The average *I.Q.* of these tested individuals was 70. Those with calendar ages up to 6 years gave an *I.Q.* of 90; while the *I.Q.* of those from 12 to 22 years was only 60. The decline here was directly attributed to the increasing effects of an unfavorable environment.

Jordan recently classified over a thousand children according to the economic levels of their parents. The total number of feeble-minded children was larger than should be expected in a gross unselected population. The median *I.Q.* of children of mill workers was 100 at age 6, but only 85 at age 13. Differences of as much as 10 points (*I.Q.*) appeared between results of non-language and language tests with the same individuals. The former tests gave a more reasonable number of *normal* children than did the latter. The evidence is interpreted as indicating that the unfavorable environment is so effective that intelligence is actually lowered with increasing years up to the calendar ages tested here, *namely*, 13 years. Whether this interpretation can be accepted is debatable. The larger number of subnormal individuals might possibly be expected in the light of various selective factors. Moreover, a "poor environment" should be effective before age six — at least, other students have maintained that pre-school children reflect the occupational levels of their parents. We can safely say that most evidence clearly indicates a fairly constant *I.Q.* at all age levels after six years. Before this time, large changes may frequently occur. Moreover, the *same* individuals were not tested in this particular study (Jordan) at different ages, as Terman and others have done. Different age groups were merely considered. Whatever the cause of the drop here from 100 to 85 may have been, we assume that it could not have been due to any decrease in the functional efficiency of the brain as a direct result of a "poor environment."

b. Foster and Orphanage Children. From the results of his studies upon the influence of foster home life upon foster children, Freeman suggests a possible change of 7½ points in the *I.Q.* level. His cases involved children with an average chronological age of 8 years and an average *I.Q.* of 95 at the time of adoption. After

four years in the foster home, the *I.Q.* level was 102.5. Children reared in an orphanage should theoretically have a more "common environment" than non-institutionalized children who are naturally permitted greater freedom or than siblings who are reared apart. If environment has a *significant* influence, it should "level" the children in an orphanage, especially those who spend years there. Some studies on siblings living in an institution less than 3 years gave a correlation of + .51; while those with 9 years of such life correlated + .48. Various studies have shown that the average difference in *I.Q.* between orphanage *siblings* is around 12 points. This is neither greater nor less than we might expect in case of siblings tested *after being separated several years.* Thus, we again discover that nature has seemingly placed man's development upon more secure foundations than can be found in an ever-changing environment. Heredity lends a stabilizing touch to human life. To a major degree it orders the rate, the uniformity, and the limits of intelligence by influencing the course of functional development.

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OUTLINE

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  b. Disease
  c. Intelligence
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CHAPTER XIX

PERSONALITY

A. *Introduction*

Learning, Disease, and Intelligence. We have considered man with the purpose of abstracting, describing, and explaining certain forms of his functional properties. Our tasks have concerned his psychological — not physiological — characteristics. We have also dealt with him in terms of his learning and his intelligence. We have sought to show that there is no one kind of learning and no one form of intelligence. Each is most easily understood by considering an individual with respect to what he does within particular situations. Learning and intelligence are simply phases of man's ordinary psychological functions; they are not independent of perceiving, acting, imagining, and thinking. Regarded in this manner, they may be better understood perhaps by comparing them with an ordinary physical disease. Such a disease is not a *distinct* entity; it is merely a phase of functional changes at a physiological level. The physician, for instance, does not assume that new or unique physiological functions appear in organic diseases. He holds that the observable and describable symptoms, for example, the fever and the chills of malaria, are simply phases of normal physiological functions. Moreover, the psychologist does not assume that new psychological functions appear in psychological disorders, for example, hysteria. Being momentarily unable to speak or act in an unusual emotional situation is not usually regarded as being peculiar. On the contrary, it is a normal phase of function. But to continue in this manner possibly for days or weeks is entirely different. The failure is still regarded as being a phase of man's ordinary functioning; but it is not normal. All disease symptoms accordingly concern what man does (does not do) in life situations. Physical and psychological diseases of a total organism or personality are forms of disturbances which are in part functional in nature. In fact, it is impossible

at times to write an acceptable description of major diseases or disorders in terms of impaired or disintegrated bodily *structures* and parts. This is true even in the certain striking cases of raving "maniacs." Moreover, no adequate description can be given of physical and chemical patterns of energy which might possibly *stimulate* the so-called insane individual and thereby cause him to reveal the various symptoms of psychological disorders. Proceeding, we find that there are no particular sense-organs to account for learning or intelligence; nor are there any particular physical and chemical stimuli. Intelligence, hysteria (disease), and learning are alike in that each involves the activities of an-organism-in-a-situation. What may be regarded as being intelligent in one situation may be considered as being unintelligent under other conditions; or the same behavior may be regarded by some as being intelligent and by others as being stupid. Actions which one man may consider to be normal, will be held by another to be abnormal. And, finally, a pattern which some men may refer to as being learned, may be described by others as being inherent. Let us clearly recognize, therefore, that man observes and speaks and acts (functions) in certain ways at certain times. Such activities may be regarded as being intelligent, as being learned, as being normal, and, finally, as being personality traits. We wish now to examine this matter of personality.

B. *General Nature*

a. It Is a Functional Matter. The personality of an individual must not be regarded as being something which he possesses independently of his psychological functions. As there are no separate functions of learning and intelligence, so there are no separate personality functions. Moreover, there is no particular kind of functional product which can bear only one label, *namely*, that of personality. There is no one distinct thing or force or agent in an individual which may be singled out and described as personality. There is no distinct form of personality energy. The matter is really much simpler than this. For instance, man may be *emotional* at times; and the particular nature of his emotional behavior may definitely constitute a phase of his personality. Again, he may possibly require considerable time to *think* about each feature of some plan of action. Or, he may *act* quickly upon every matter raised with him in a way that, to

many, is disconcertingly brusk. These, also, are aspects of personality.

Generally speaking, then, personality is commonly concerned with man's *actions*, especially in so far as they occur in emotional situations. It touches, therefore, to a lesser degree upon an individual's tendency to reason or imagine. When we report that a man has a pleasing personality, we do not commonly consider him with respect to his possibly brilliant thinking or his keen imagination; we report largely in terms of the degree of our liking with respect to his other functional properties. As a matter of fact, individuals occasionally refer at one moment to a man's intellectual brilliance and at another moment to his colorless personality. Some psychologists actually place intelligence as a wholly negligible factor in the total personality picture. It is evident, of course, that five men may receive the same score on an intelligence test, yet be described very differently in terms of their several personalities. It is doubtless true that, in many fields, personality factors determine success or failure to a much greater extent than does intelligence.

b. It Concerns Particular Situations. Strictly speaking, personality includes various unlike psychological characteristics of man as they are revealed in particular situations. It is quite impossible to understand personality if the nature of the situation in which an individual functions is disregarded. The so-called personality "traits" are actually different functional products which emerge under definite conditions. A man may be said to have one kind of personality if he hits a dog or strikes a woman; that is, "cruelty" is a personality "trait." But the matter is very different if the dog is mad or if the woman is beating his child with a hammer; we do not now regard the man as being cruel. This is to say, the nature of each situation must necessarily be considered in any description of personality. We must accordingly regard the individual in terms of the meaningful properties of his life situation. We can understand his personality by understanding the way in which an individual observes these situations. We may speak of the personality of a man by saying that he is cheery, considerate, honest, affectionate, good-natured, courageous, aggressive, and bashful; or that he is gloomy, rude, dishonest, cold, ill-natured, cowardly, and submissive. It should be evident that such descriptive terms actually refer to meaningful patterns in particular situations. When the particular situation is changed, the matter then

becomes different. A man who is *affectionate* on too many different occasions may be described as having a personality unlike that of the man who is affectionate in a few situations. Moreover, in the judgment of her friends, a woman may possibly enjoy a fine personality, yet be an abject coward during a storm or when facing a mouse.

It is accordingly understood that personality cannot be divorced from *specific* situations. The measure of a man or woman must always be taken under definite conditions; and once taken, it necessarily finds its widest significance when confined to that type of situation in which it was derived. To maintain that personality is something which exists independently of particular situational conditions is to destroy the major value of the term. Most students apparently recognize this fact. By way of illustration, we say that no administrator who intends to speak truthfully would ever write descriptively of the classroom personality of an instructor without ever having observed him under those conditions, or without having secured acceptable reports from other men who had visited his classes. It is impossible for one to report reliably upon the classroom personality of a man if observation of him has been solely confined to his home or to his club. The full recognition of this truth should materially aid the student in securing an understanding of this general problem.

c. It Represents an Abstraction. Like human intelligence, personality definitely represents an abstraction. Certain phases of human life may be *abstracted* from all others and considered as though they were independent aspects. No one, of course, has ever observed a total personality. One simply observes some feature of an individual's behavior under definite situations. At one time, one particular feature may stand out clearly; it may, in fact, dominate the "personality picture." At another time, however, another feature may possibly become dominant. Thus, after many years of following others, an individual may actually assume leadership under a particular set of causal conditions. Or, the same person may definitely follow at times and lead at other times. The records of history are filled with accounts of men who were lifted into leadership by particular situations; it is also replete with striking instances of failures when leaders were most needed. For many years, Grant was commonly recognized by many men as being a failure. Aside possibly from his drinking, he seemingly

accomplished very little. Yet the conditions of the Civil War finally revealed him to be a military leader of outstanding ability. What was true in this particular case, undoubtedly holds generally. We can accordingly find no scientific justification for the common assumption that there is one "true" or "real" personality. What is true must depend upon what is done by an individual at any given time. Each situation must stand as a determiner and a test. Dominant characteristics may not emerge until many years of an individual's life have passed. We point thus to the striking difference between two periods of Napoleon's life: At school where he showed no indication of leadership, and where he was held very lightly by the members of his class; and in the army where his genius appeared and gave significance to his life.

C. *The Problem of Consistency*

a. A High Degree Possible. It should be clearly understood, however, that there may be a high degree of consistency in the various patterns which partly comprise personality. Within limits, personality is as consistent as intelligence. Such consistency directly arises, however, from the nature of an individual's goals, ideals, standards, aims, purposes, desires, and forms of satisfactions. Personality consistency stands on a meaningful basis. Within life situations, when such are characterized by common meaningful characteristics, a high degree of consistency may unquestionably be found. Thus again we discover the significant part which meaning plays in the determination of life activities. Whether one is bashful or bold, affectionate or cold, aggressive or submissive, and honest or dishonest must depend in last analysis upon the particular significance of an observed situation. Not infrequently we face the question: Should an individual always speak truthfully? In science, there can be but one answer. But beyond science, other meaningful values of different significance enter. To realize this fact fully is to settle finally the problem of whether or not an individual can properly be scientific in all matters. Regardless of his *scientific* training, the man who would deliberately disgrace his wife, daughter, or sweetheart by speaking honestly about her when a lie might possibly protect her would be an unusual individual with a rare form of personality. If we were to discard meaning, we would thereby cast aside the only key to an understanding of personality consistency. Or, if we were to deny that

man responds to observable characteristics of a situation, we would thereby destroy the only adequate approach to psychology. Life moves ahead from day to day; the physical and chemical environment changes from moment to moment; and new objects and situations are constantly being observed. Yet, a surprisingly high degree of psychological stability may be found; individuals persistently reveal similar characteristics. This stability rests upon the firm foundation of meaning. The life of an individual may be roughly compared, for purposes of understanding, to a ship that is anchored in open waters. The winds, tides, and currents may sweep strongly against it, so that it shifts here and there. But it swings back, again and again, to assume its old positions at anchorage. Man may be buffeted by many adverse situations, yet as a result of some goal-meaning he is given stability; he is enabled to avoid drifting.

b. A Matter of Situation. Consistency is a situational matter. As long as fairly similar meanings are observable, the same personality patterns must appear. We assume, of course, that causation holds as rigidly here as elsewhere. The major cause of consistency is the realization of a particular end-result. An individual, we say, wishes to be kind to his own relatives or to those who belong to his own group. Wherever these particular meanings of belonging and obligation exist, kindness emerges. It may not appear under any other condition. Those who are familiar with the story of *Rigoletto* and his sheltered daughter can better understand this fact. We normally expect individuals to lie to protect those whom they love. Even the law does not require a wife to testify against her husband. It has long been the code "among gentlemen" to protect the "good name" of the women of his level. A man who refuses to acknowledge such obligations is not liked; he does not have the right personality. At times, when an individual is met who does not belong to a particular group, snobbery, indifference, and cruelty may appear. Many accordingly find it easy to be good and generous to a loved one, but difficult when an enemy is concerned.

In a similar way, we recognize that persons who are honest under one set of conditions, may be quite dishonest under a different set. Cheating, for instance, may readily occur during the course of an examination, but not while participating in a game. A few years ago, a large midwestern university was finally forced to drop the

use of the "Honor System" of examination. It became definitely known that many individuals including those who were outstanding as leaders in extra-curricular activities were being openly dishonest on the examinations. The results of experimental studies indicate the importance of meaning; when two situations are quite different the probable chances of cheating as indicated by the coefficient of correlation are very low. The coefficient is around + .20. When life situations are quite similar, however, the correlation runs much higher — in some cases it reaches + .70. What is true of dishonesty, is essentially true of leadership. The coefficient is very low. A child may be a leader in his schoolroom but a follower on the school ground. An adult may be a strong leader in one field, but a follower in another field.

c. Cheating, Lying, Generosity, and Stealing in Different Situations. Some interesting experimental data have been gathered on the extent and consistency of cheating, lying, generosity, and stealing. The results clearly reveal that such patterns appear under certain conditions and that, as long as the same conditions exist, a high degree of consistency is to be found. Several thousand children were studied under dissimilar conditions such as occur in the classroom, on the playground, and during games (contests) in the attempt to discover uniformities and relationships in personality traits. They were asked, for instance, in the classroom to work problems and exercises which could be easily and accurately checked. The exercise papers were collected and so checked that a slight change in any of them could be detected. They were then returned to the children so as to permit them to assist in grading their own papers. By rechecking these papers, the extent of cheating by particular individuals was accurately determined by the experimenters. The children were also given an opportunity to play games which were so arranged as to make it possible for a child to cheat (lie) without any apparent chance of being discovered — the children, for instance, could carry more than one object, when the game called for only one. Or, they could report scores which were impossible under the situation. The same children were also given a chance to handle money in such a way that stealing, under the impression that detection was impossible, might easily occur yet could be accurately checked. In still other situations, the children were given personal articles (box with pencils, etc.). Later, as if by sheer chance, they were

asked if they would *voluntarily* share a few of these things with some poor children who had none. A careful but secret check was made in each case on the extent and the readiness of the children's giving. In all these cases, the apparent reward was merely doing *well for its own sake or doing as well as others or making a good impression by excelling.* There was no hint of any compulsion or of any checking or of any rewarding. Each situation was as casual as it could be made; artificiality was carefully avoided.

The data from these studies show "consistency" as well as "inconsistency" in these particular personality characteristics. There is "consistency" under like conditions; there is "inconsistency" under unlike conditions. They clearly reveal that children may readily cheat in the schoolroom, but not on the playground or in ordinary games of play. Moreover, they may possibly steal; but they may not lie or cheat. Again, they may lie under one situation, but be truthful under various other conditions. In general, it seemed that the experimental children who came from the so-called better homes and neighborhoods were slightly more inclined to do less cheating, lying, and stealing than those who came from the poorer homes and districts. Such tendencies are to be attributed partly to a difference in the satisfaction of particular existing needs, and partly to a possible difference in parental attitude toward honesty. That is, a child who has some pocket money is definitely fortified against stealing. The better children accordingly faced less temptation in the particular tests which provided opportunities for theft. Moreover, a child who is whipped or punished for slight misdemeanors shortly learns the value of lying. The children who come from better homes possibly escape more punishment, in this respect, than do children from poorer homes. Differences in these cases are understandable, therefore, in terms of individual differences in needs (desires) to have and to avoid. In short, the one group was more honest than the other because the actual satisfaction that arose from dishonesty was less in the one case than in the other.

d. Honesty. Such studies indicate that there is no general personality trait, force, or cause such as honesty. There are only particular human beings who are honest under particular situations. To say that a certain child *cheats* has very little significance, unless one is also informed concerning the situational

conditions under which such behavior appears. An individual who is regarded as being dishonest may actually fail to cheat where many others do so. Moreover, there is no general trait that always expresses itself either by lying or telling the truth. There are, again, only human beings who lie under certain conditions, and tell the truth under other conditions. Again, there is no one cowardly "trait"; but only individuals who are cowardly under certain life situations. Now, this is essentially what was implied when we pointed out that there is no *intelligence* which may be regarded as being a distinct and separable thing. There are only individuals who are intelligent when measured in certain highly standardized situations. It is, furthermore, what the biologist seemingly intends when he asserts that *life* as he studies it is no distinct and separable thing — there are only *living* organisms.

e. Generosity. The data indicate, moreover, that there is no generalized trait of generosity. There are only individuals who may be quite generous if one has much to give, if one does not have much need, if one hopes to secure profit or avoid punishment, or if one places little value upon some object. In this study, the poorer children who had never before owned a box (pencils, etc.) must certainly have faced a quite different situation from that of the children who had considerable equipment in their desks. Need and value must be considered in understanding human behavior. We may easily understand the individual who cheats on an examination. If the need is very great, as measured in terms of possible consequences, cheating is more likely to occur than when the end-results are quite unimportant. The major difficulty in training individuals in accordance with certain group standards is not so much concerned with the strength of any given need as it is with the particular mode of satisfying the need. It is quite significant, as here shown, that the same individuals will reveal such unlike patterns. Since commendable behavior actually *does* occur under certain conditions, it is definitely suggested that *desirable* behavior patterns may possibly be substituted in the place of the undesirable, if only the proper remedial steps can be taken. Such recognition accordingly encourages us to scrutinize each particular set of causal conditions underlying an undesirable pattern instead of talking vaguely about universal characteristics. Causation is always specific. There is no generalized determination. A care-

ful study of man's personality furnishes excellent evidence of this fact.

The student will do well to recognize that a proper understanding and an adequate treatment of a human being rest upon the realization that a particular pattern must necessarily appear in a particular situation. We are not materially aided, therefore, by considering deceitfulness or generosity or truthfulness in general. When we discover, for example, that a child carries away certain objects which do not belong to it, we can proceed to deal with it in terms of that specific matter. If we will approach the individual in this way, we may possibly get at the causal factors and remove them, thus removing the result. This is a safe way; for it emphasizes causation. It holds that under particular conditions, only one type of product can possibly appear. And as causes change, so does behavior.

D. *Personality Changes*

Striking changes in human behavior, especially in social situations, throw considerable light upon the problems of personality. In psychological disorders, for instance, a man who has been kind, considerate, and temperate may become cruel, inconsiderate, and intemperate. When such changes become marked, they furnish evidence of the existence of a serious functional condition. The preliminary psychological symptoms which accompany syphilitic infection of the brain generally assume the form of subtle personality changes. With time, these become more evident; they are then regarded more critically. During the earlier stages here, an individual may be bitterly condemned. When understanding is lacking, emotion commonly flourishes. Only when the personality changes have become exaggerated, may men recognize that a cause, other than "sheer devilry," must be at work.

At times, an individual may show two or more personalities. This is especially true in certain cases of hysteria. Here again, the changes must be somewhat pronounced in order that the individual may be properly and intelligently regarded by his fellows. In hysteria, the individual may possibly lose certain memories, including even those of his identity. A different sort of individual accordingly appears. Such personality changes may possibly occur only at long intervals in the life of some individual; or two personalities may fluctuate several times in one day. Goddard, for example,

mentions a case of a girl who manifested eleven such changes during one day. Preceding one of these changes, this particular individual would usually fall suddenly "asleep" (as quickly as one may faint) to awaken shortly showing one of two personalities. In one stage (Norma), the girl was 19 years of age; in the other (Polly) she was 4 years of age. Norma was "normal," and Polly was the "alternating" personality. The student can understand from the nature of this case why psychologists speak of dual personalities. The duality here mainly concerned differences in activities in the same social situation. Norma, for instance, was quiet, even-tempered, and somewhat reserved. Polly, however, was irritable, troublesome, and argumentative. These are functional differences. The treatment consisted of hypnotizing Polly and attempting to awaken her so that she would have full memories of Norma's life, and of hypnotizing Norma and attempting to waken her with memories of Polly. As treatment proceeded, the girl came to manifest *at the same time* characteristics which were formerly peculiar to the one or to the other personality pattern. Norma now showed some of Polly's characteristics and Polly revealed some of Norma's actions.[1]

Hypnosis is a psychological method which may be experimentally used to study directly some functional changes quite similar to those occurring in dual personalities. In this way, it is actually possible to induce amnesia in a normal individual. Various situations which were earlier perceived may now be forgotten. By means of proper functional preparation and instruction, a whole period (relatively very short, of course) may be dropped. Functional losses may thus be produced. The individual may not be able to perceive, or remember, or act. Such loss is interesting. If it can be deliberately induced through some particular environmental agency (by another individual), we need not assume that a peculiar or strange agency is involved in the many cases where it is not deliberately produced. The fundamental mechanism may legitimately be assumed to be identical. If it is caused in the one case, it must be in the other. The task of understanding accordingly concerns the discovery of the particular situation which produced the functional losses. Hypnosis thus works both ways. It may be used experimentally to induce memorial losses, and it may be used therapeutically to increase functional adequacy.

[1] Goddard, H., "A Case of Dual Personality." *Jour. Ab. and Soc. Psychol.*, *21*.

E. *Personality Is More than a Sum*

It must also be understood that an individual's personality, as it is actually considered, is not identifiable with some five or twenty-five separable characteristics. Strictly speaking, man is a functional unit; but his several activities are known in terms of differences in functional products — in what is done. A human being, regarded as a total personality, is more than a series of traits which may be listed in a 1, 2, 3 order. Two tonal or olfactory properties, when brought together, will often produce a resulting property which is quite different for either property. The resulting property is not a sum of two others. In the same manner, we recognize that personality cannot be understood as being the *sum* of a certain number of simple independent traits.

If the student will seriously attempt to describe the precise basis for his claim that his friend has a pleasing personality, he will better understand our point. Such a task is in fact quite like that of trying to fix the exact basis for the observed *familiarity* of his friend's face. This, he knows, is not just a matter of his friend's eyes, for they can be closed without affecting his familiarity; it is not a matter of his mouth; for it can be hidden; it is not a matter of his hair, for it can be covered or shorn; and it is not a matter of his skin color. Familiarity is a unique meaning which characterizes a total object. It is not composed of *parts;* nor is it a *sum.* Personality will be better understood if it, too, is considered in the same way. Even though we may speak of various personality traits, it is understood that we are concerned with a specific meaning which definitely characterizes an individual whom we observe in a situation.

F. *A Phase of Social Psychology*

Personality is largely a matter of the activities of an individual in social situations; that is, it concerns the way in which other persons regard the behavior of an organism. Man may accordingly imagine and reason and act very extensively in the complete absence of other human beings without the problem of personality ever arising. Scientifically speaking, an isolated individual has no personality. The proper situation is lacking. It is, therefore, a phase of social psychology. We accordingly know and measure human personality in terms of meaningful situations which involve more than *one* human being. Thus, if other men are favorably

impressed by an individual and if they seek and admire him, he may be said to have one set of personality traits. If other men are not impressed and if they avoid and do not admire him in terms of what he does, he has another group of personality traits. We can say that if an individual tends to seek other human beings and reports that he is happy only when with them, he may be said to have one personality. On the other hand, if he does not care much for social situations, if he is most happy when doing his own work, regardless of its possible relations to other human beings, he has another sort of personality. In so far as there is a discoverable degree of consistency in the particular type of situation in which an individual finds satisfaction, he may be said to have a consistent personality. Since personality concerns social situations, we should expect emotional products and attitudes to play a major rôle.

An understanding of the part which emotional (affective) properties play in personality may be derived from a brief examination of some methods of study widely employed in this field. In Thurstone's tests of personality we find such questions as the following type: Do you like to be alone when you work? Do you resent strict discipline? Do you usually control your temper? Do you lose your head in dangerous situations? Are you troubled with shyness? Do you worry over possible misfortunes? Are your feelings easily hurt? Do people think you are selfish? Do you usually trust people? And, do your interests change greatly? In Cleeton's tests on sociability, we find somewhat similar questions, such as: Can you talk entertainingly? Do you defend your ideas through thick and thin? Do you enjoy watching people in a crowd? Are you thoughtful of the feelings of others? And, do you think politeness pays? In a test of affective values formulated by Yoakum we find the individual asked to indicate how he likes or dislikes many dissimilar objects and situations such as: fat women, brunettes, bow-legged people, spendthrifts, immoral people, nervous people, living in the country, dancing, detective stories, vaudeville, and fishing. As a final illustration, we refer to a test developed by Moss in which the individual is asked to indicate by a check the proper procedure in particular social situations of which the following is an example. Joe Hartley is a newcomer in a school where hazing is the custom. A crowd of the leaders take him out to haze him. It would be best for him to:

Maintain his dignity at any cost
Resist the hazers to show that he is game
Treat the hazing as a joke
Report the names of the hazers to the authorities

G. *Types of Personalities*

Many students possessing little understanding of psychology seemingly assume without question that human beings may be readily placed into various classes or types of personalities. Students seem to believe, for example, that blondes and brunettes may be differentiated upon the basis of distinctive psychological traits. We do not wish to imply that human beings do not differ. We have previously sought to show that they do. But men may differ without differing in type. Even among the insane, it is only rarely that clean-cut types appear. Causation is so complex and nature is so lavish that things gradually shade off into other things. In fact, whenever a large number of individuals are considered with respect to their possession of any particular characteristic, they are found to distribute themselves in accordance with the normal frequency curve. Under certain conditions, if a bimodal distribution such as is shown in Fig. 123 were to be obtained from a number of measures, it would suggest the presence of two distinct types or kinds of individuals. By accepting certain cases and rejecting others, a distribution of this sort may be secured. If one were to take platinum blondes on the one hand and very dark brunettes on the other hand and arrange them on a common base line in terms of hair color, a bimodal distribution would result. If one were to plot the heights of a group of individuals composed of six-year and twenty-year individuals, a bimodal curve would result. If one were to select individuals with respect to honesty and dishonesty, or loyalty and disloyalty in particular situations, he would also obtain a similar distribution. But when large unselected samples of a population are plotted in terms of any particular characteristic, for instance, honesty or dishonesty, a normal frequency curve is usually obtained. Such

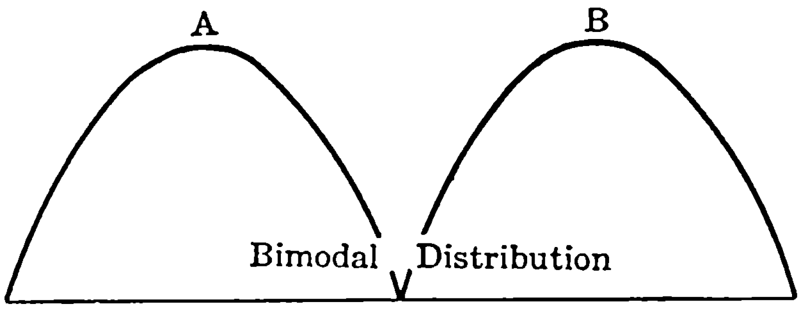

FIG. 123. Two types could be represented in this manner.

curves definitely imply that most individuals are actually *ambiguous* — they are neither one thing nor another. Perhaps we may say that most individuals are all things to all men (situations). In every case, however, there are a few who stand far apart at each end to represent the extremes.

a. Ascendance and Submission. One attempt to differentiate individuals into types or classes deals with them in terms of ascendance and submission. Some human beings are seemingly more domineering than others; others are in turn more submissive. Data obtained from the use of an ascendant-submissive scale with several hundred individuals are shown in Fig. 124 (Allport). The *six* end here represents the most submissive and the *one* end represents the most ascendant individuals. There were a few of this group of students who were markedly submissive and a few who were strikingly ascendant. Many, however, were apparently dominant as measured by some test situations and submissive in others. Some individuals may manifest such dominant or ascendant characteristics as: being able to haggle over prices in a store or openly resisting some domineering individual. At the same time, however, they may manifest such submissive characteristics as refusing to make friendly advances to strangers or attempting to escape from any major responsibility.

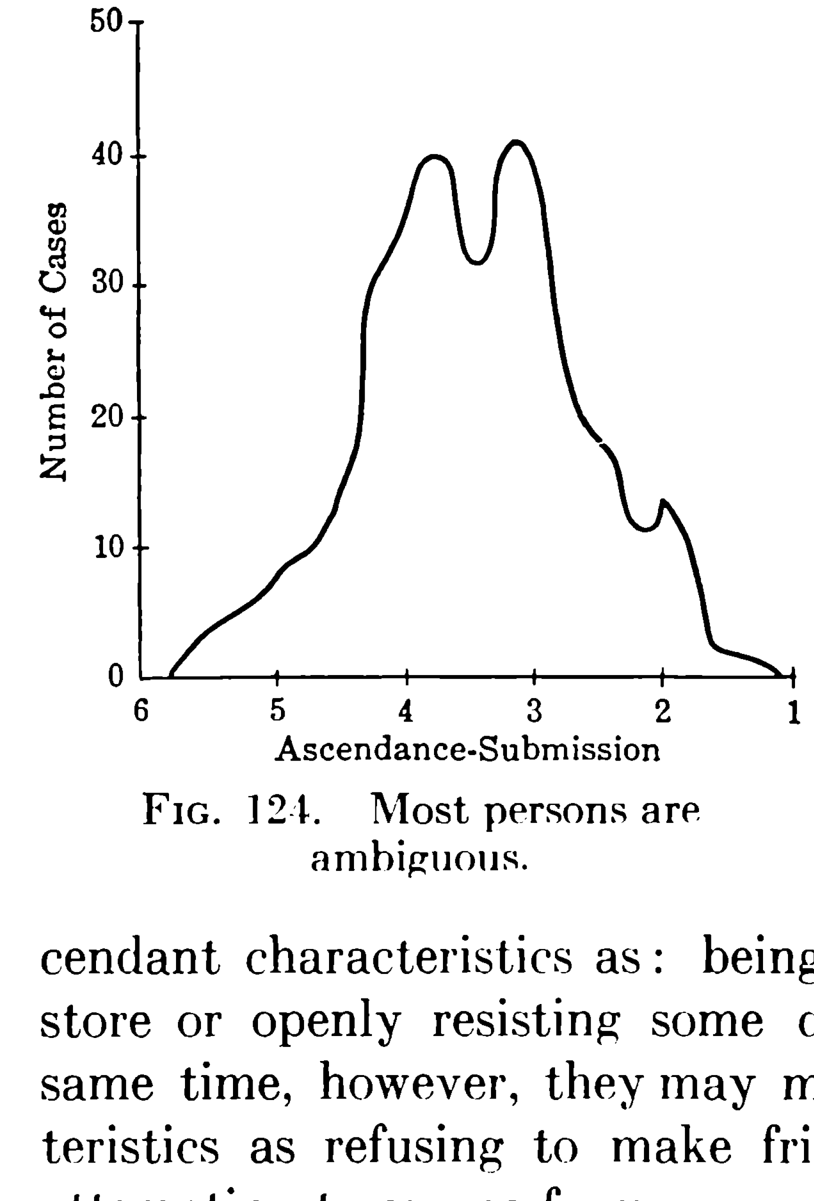

FIG. 124. Most persons are ambiguous.

b. Introversion and Extroversion. Another suggested approach to types of personalities is by way of introversion and extroversion. These two large classes were originally suggested by Jung to include two kinds of human beings when considered in terms of the nature of the things they think about, the things they like and dislike, and the things they perceive. The introvert is, for example, emotionally indifferent or cold; he has little interest in practical and worldly matters; he is inclined to be shy, retiring, and quite self-effacing; and he is disinclined to mix with the crowd and to speak freely of his opinions and the things which interest him. Moreover,

he is awkward and usually ill at ease in the presence of strangers as well as being unable to participate freely in any give-and-take discussion. He is inclined, furthermore, to consider matters (even of a light nature) rather thoughtfully before taking action, so that he seems unduly hesitant and uncertain when some situation lays an unexpected demand upon him.

The extrovert, on the other hand, is inclined to be effusive and emotionally impulsive. He likes the things of the world and goes directly at them. His major sources of satisfaction lie in a busy world. He is less subtle in his actions and less deliberate in his thinking. He finds it rather easy to express and to defend his own opinions, which he holds rather highly, and is less inclined to be upset in any give-and-take discussion. Since he is happy when with the crowd, he finds little pleasure in his own company. He is neither very self-sustaining nor self-sufficient. He must be encouraged by outside sources in order to maintain himself at an efficient level. He is regarded by those who hold to these types as being the stuff out of which good leaders, husbands, salesmen, executives, lodgemen, politicians, orators, demagogues, and teachers are made. The introvert, on the contrary, is inclined in the direction of scientific research, music, poetry, some forms of art, and bachelorhood. It should be evident that some men would say that individuals should be trained to be extroverted; other men would as strongly maintain that the introvert is the desirable type. As a matter of fact, most individuals belong neither to the one nor to the other. Individuals may show so-called introvert patterns under one situation and extrovert patterns under another situation.

The author is repeatedly impressed by the striking functional changes which frequently follow a few drinks. The timid, for example, becomes bold; the moody grows gay; the reticent becomes confidential; and the reserved turns effusive. It has been suggested (not too seriously) that the amount of introversion might be measured by the amount of alcohol required to produce extroversion. The sudden changes which occur under the above conditions are instructive. They properly point the thoughtful student. They force him to ask: What *is* the nature of a human personality that it may be so easily, yet so greatly, changed. He may finally realize that the meaningful situation is greatly changed, for instance, under intoxication; and that the behavior which appears there is wholly consistent with the situation. Moreover,

the behavior is such as to remain unknown except in terms of such situations. One cannot directly know what a man will do when intoxicated, until one has observed him under such conditions.

c. **Pyknic and Asthenic.** A third and quite different grouping has geen suggested by Kretschmer. The basis of his classification is physique. Some men, he suggests, fall into short and round types (pyknic), while others fall into tall and slender types (athletic and asthenic). The first type of bodily pattern apparently tends toward the extroverted class of Jung. Kretschmer claims, from an examination of several hundred unselected cases, to have found that his pyknics are inclined to develop a particular kind of psychological disorder — the manic-depressive sort. In this functional disease, the individual may at one time shout, laugh, shake hands, back-slap individuals, move objects, and rush around as if very busy at life affairs. In the depressive stages, he may sit quietly or show prolonged periods of weeping. He may complain that the whole world is against him, that he has no future, and that nothing is worth-while. The athletic and asthenic individuals, on the other hand, are regarded as being introverted. According to Kretschmer, they are prone to develop dementia praecox (early dementia). In this particular functional disorder, an individual, while possibly an adolescent, may start to decline in a psychological manner. He loses interest in life affairs; he gets "out of touch"; he withdraws from the perceptual world to live in a dream (imaginational) world. He may become completely dependent and helpless; he may not trouble to look after himself. It may become necessary to wash, dress, and feed him. Very grossly speaking, he may be compared with one who is so deeply interested in a thought problem that he does not trouble about ordinary matters. It is well-known, for instance, that when in the midst of an important experiment, Edison would eat only when almost forced by his wife.

H. *Some Methods of Studying Personality*

a. **Biographical (Genetic, Case).** A valuable tool which finds wide employment under certain conditions is the biographical, historical, or case method. It serves in part to eliminate the remoteness (artificiality) which exists in certain other methods; at the same time, it places the individual with respect to particular life situations. This method aids in uncovering the early history of an individual in his home and community. It thus discloses

significant contributory events in his personality patterns. It attempts to trace various developmental sequences through the years of an individual's growth. It may accordingly permit one to establish a relation between such possible factors as injuries, incidents, sources of satisfaction on the one hand, and delinquency and other socially undesirable patterns on the other hand. But like all tools it has its limitations. It depends in part upon the descriptive reports of the individual himself and of parents, physicians, and associates concerning events which may have occurred many years earlier. The value of such reports, affected and colored as they frequently are by many unlike circumstances, is necessarily limited. More important, perhaps, is the fact that many significant characteristics actually emerge and serve as determiners of behavior without anyone being very clear concerning their early stages. Causation is always difficult to determine even when the various agents are actually present in some experimental situation. It is extremely difficult to uncover the determining events when several years may have elapsed.

b. Questionnaire and Inventory. Sample forms which indicate the general nature of these methods have already been indicated. These methods commonly attempt to reveal affective attitudes and preferences with respect to particular objects and situations. It is assumed that by sampling widely with respect to the things which a person likes or dislikes and desires or fears, it is possible to derive a representative picture of his full personality. When the score derived from an emotional inventory reveals an unusual degree of "troubles," an individual might properly be advised to consult a reputable source for advice and guidance.

c. Rating Scales. Another widely used method in this general field involves the use of rating scales. An individual may be rated by several persons who know him quite well, or by others who observe him closely under the specific intention of comparing him with others. In the usual rating scale, a variable number of items (10 to 100) each of which touches upon a situational characteristic may be arranged as shown in Fig. 125. The scale shown here is used in a midwestern university to secure the opinions of instructors upon students in order to deal more effectively with them. It is used with both good and poor (all) students. Here are seven items, each of which is divided into several parts. The instructor is expected to place a check at the proper place along each line to describe a par-

PERSONALITY RATING

NAME OF STUDENT-- DATE----------------------

						No opportunity to observe
1. *Scholastic Zeal* Does he display enthusiasm for school work?	Unresponsive	Usually indifferent	Studious	An energetic student	Craves scholarly work	
2. *Intellectual Ability and Aptitude* Does he have the ability to assimilate knowledge and easily to adjust to new situations?	A dull pupil	A slow learner	An average student	An alert student	A keen student	
3. *Initiative* Is he a resourceful and original thinker?	Needs constant supervision	Needs occasional prodding	Prepares assignments	Completes suggested supplementary work	Seeks and sets for himself additional tasks	

FIG. 125. One form of rating scale.

4. *Integrity* Is he honest?	Positively dishonest		Tries to be, but fails sometimes; unreliable		Unquestionably honest
5. *Leadership Ability* Does he have the ability to secure a following?	Definitely a follower	Tries but fails frequently		Usually successful	An inspiring leader
6. *Social Attitude* Is he group conscious? Does he have a spirit of service?	Anti-social	Self-centered	Has no positive attitude; neutral	Usually considerate of others	Strongly altruistic
7. *Emotional Control* How does he control his emotions?	Too easily moved to anger or fits of depression, etc.	Tends to be over-emotional	Usually well balanced	Well balanced	Exceptionally well balanced
	Unresponsive; apathetic	Tends to be unresponsive			

Is the foregoing an individual, or a composite rating (by more than one instructor)? ______________

If an individual rating, how well do you know this student? ______________

FIG. 125 (Continued).

ticular individual most adequately. The rating scale is, in fact, an objective method of securing the opinions, judgments, and beliefs of particular individuals about some one person. Thus, it strikes at the very essence of personality, which, as we have said, directly concerns what others think about an individual. That is, it concerns what an individual does or what effects he produces upon other human beings in particular situations.

The rating scale is definitely valuable in securing a particular kind of evaluation of an individual; it is much better than an ordinary verbal or written statement. The value accrues from the fact that the rater is forced to consider the person in terms of a definite number of traits. This tends to prevent hasty consideration. It also tends to eliminate an evaluation based upon some one characteristic; for it often happens that men, who are asked to pass upon an individual, observe and describe some particular feature and tend to disregard all others. The employment of a rating scale demands, however, that he consider an individual from various angles. The use of such devices also enables a number of individuals to consider a particular individual on a common basis. The several results may then be pooled to secure a more trustworthy evaluation. The opinions of ten men are more valuable than those of one man, especially when they have equal acquaintance with an individual. Finally, by using some form of scale, it is possible to recheck at later times, thereby securing information upon the consistency of the method.

In Fig. 126 we show one method of giving a personality picture of an individual based upon tests and ratings. This represents a student who was recognized by his associates as being an outstanding leader and college politician. The middle horizontal line represents the median of his group. This figure is taken from a study of Bowden's on student leaders in colleges in this country.

d. Performance Tests — Experimental Situations. As an illustration of such methods, we refer to some studies of Marston on young children in connection with the study of introversion and extroversion. The children were given simple tasks to do, and the length of time which each child spent without being able to work them successfully was regarded as a measure of persistence. In other cases, the experimenter would remove one object with which the child was playing and offer another in its place. Some children would readily relinquish the object, while others would resist. By

such tests, measures of resistance or self-assertion and submission were obtained. Other children were observed in terms of their actions toward a situation involving a stranger. A child was brought to a room where Marston was seated, apparently interested in playing with a toy. The child, left at the door, was thus given an opportunity to approach him. A time record was kept. If the child hung back, he would glance at the child and then go back to

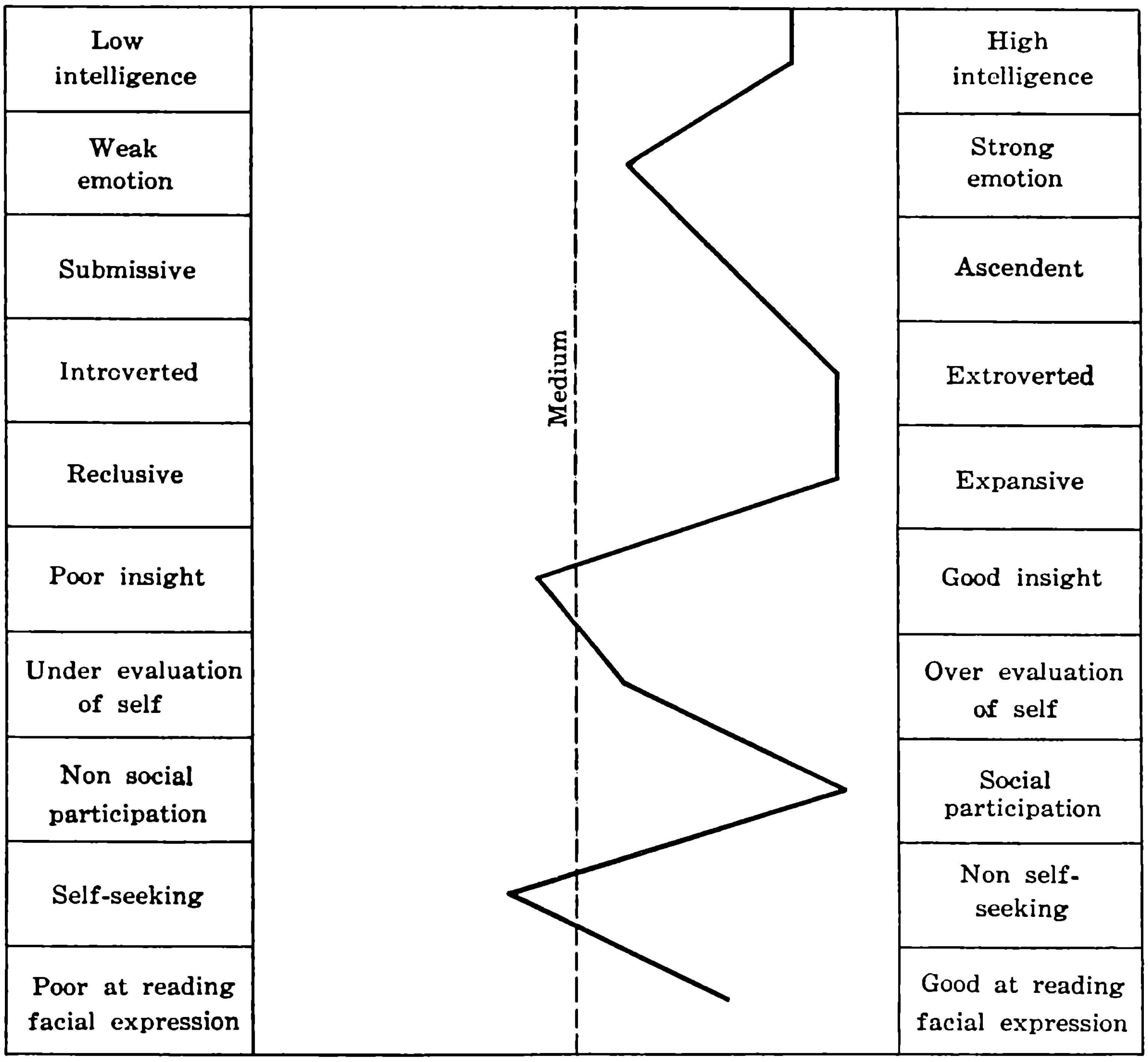

FIG. 126. A line picture (profile) of a student leader.

his playing. If the child did not advance, he would then smile pleasantly at it. Should hesitancy still be displayed, he would invite the child to come and play with him. Some children would refuse all advances; they would have nothing to do with him. Other children would advance hesitatingly; still others would immediately come forward, talking and perhaps asking questions as they advanced. Striking differences thus appeared in children well below school age. In most cases, there was no hint in the child's history of any training condition that might cause either

pronounced unfriendliness or friendliness. Whatever the causes of the discoverable differences in the behavior of children in such situations may be, they clearly exist at the pre-school level. Personality trends thus show themselves very early. Some children never reveal themselves to be very talkative; others run on continuously. Some seem to be "good fellows" in their first years; some demand that the first advances or overtures be made by others. Even in the same family group one child may be retiring and another may be aggressive. If we could but understand the nature and operation of the causal factors at these earlier simple levels, we should probably know a great deal more about why adults act as they do.

I. *Explanation*

We have previously reviewed the essential facts of functional determination. There is essentially nothing new which we may say about personality. We assume that under the heads of heredity, personal history, and environment must go each and every cause of man's personality. Widespread similarities as well as striking differences must be considered in terms of these large causal divisions. We assume causation; yet in so many significant cases we cannot show it. If the physician and psychiatrist, for instance, are unable to reveal the actual determining factors in the lives of many individuals who are roughly classed among the "raving maniacs," it is scarcely to be expected that causes may easily be discovered in the "normal" individual. The quest of causation is both very fascinating and baffling. It is scientifically and practically regrettable that the most important phases of human life should be so difficult to approach in this manner. Here, science is rich in theory but poor in fact. Among the several possible ways of explaining personality, we wish to consider the claims of the endocrinologist and the psychoanalyst. We shall pass over such changes in personality as arise as a result of old age, bodily impairment, and physical disease.

a. Endocrinology. Claims which are most striking in terms of their extravagance have come at times from some students of the endocrine glands. The endocrine glands, being without ducts, discharge their several products directly into the blood stream and thereby influence all regions of the body. It is maintained that they also affect every function both physiological and psychological.

Ambitious attempts have accordingly been made by certain writers to build man's personality upon a chemical basis with the several hormones (chemical products) as the materials and the several endocrine glands as the architects. Let us briefly examine this general problem in the light of our present knowledge. While doing so, let it be clearly recognized that we are dealing with fundamental hereditary conditions. Man's glandular mechanisms are biological contributions; they have been set in him by the race.

The *gonads* (sex glands) profoundly influence man both psychologically and biologically. They determine in part the development of the several secondary sex characteristics, such as voice, hirsuteness, bodily contours, and size. Such characteristics may in turn play a major rôle in determining an individual's personality. The masculine woman and the effeminate man may suffer enormously simply because they are not observably like others. They may become timid, "sensitive" to comments, sullen, and unhappy. Yet only in the more extreme cases, perhaps, can any effect upon intelligence be attributed to deficiencies in these particular physiological functions. Thus, the effects of castration seem to concern mostly such matters as activity and, perhaps, pugnacity. The *pituitary* gland situated at the base of the skull produced several hormones (*one is pituitrin*) which seem in general to have striking effects upon the organism. Excessive or deficient production of any one of these hormones may have marked consequences. Excessive functioning may produce either gigantism (see Fig. 127) or unusually large members such as hands, feet, and nose in the more mature person. It is also assumed to be related causally to aggressiveness and persistence. On the other hand, deficiency may produce a normally intelligent but a submissive, good-natured, and vascillating midget.

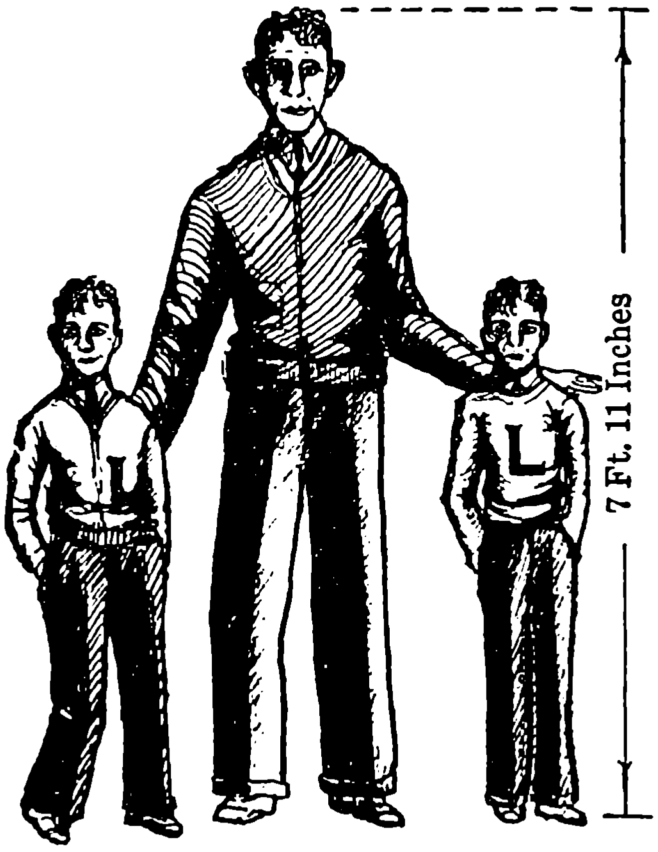

FIG. 127. How different the matter would be if our endocrines could make us into intellectual giants!

The *thyroid* gland which encircles the windpipe also serves as a significant determiner of biological and psychological functions.

When enlarged, it forms the bodily basis of goiter. Congenital deficiency in functioning (hypothyroidism) may cause (be accompanied by) a sluggish, stunted, stupid, or feeble-minded individual. The dwarfish idiotic cretin furnishes a striking example of what under-functioning of this gland may in part produce. Thyroid deficiency is also accompanied by lower bodily temperature, slower breathing rate, decreased activity, and lower oxidation rate. By administering an extract of thyroid tissues taken from animals, remarkable changes may be induced at times in such deficient individuals. Whether a normal man can be produced out of a cretin child, for example, remains to be demonstrated. Excessive functioning of this gland (hyperthyroidism) is accompanied by rapid physical development (including sex changes), excessive restlessness, and increased irritability. It does not seem, however, to increase the level of intelligence; that is, produce a superior individual.

There is a subtle relationship between emotional functioning and thyroid production. Long periods of emotional excitement tend to produce hyperthyroidism with various attendant symptoms. During the World War, for example, there was a striking increase in the number of such cases. It may also be recognized that a prolonged period of pre-marital engagement, especially where there is strong emotional tuning, may possibly be accompanied by functional impairment.

The *adrenal* glands lie above, but functionally independent of, the kidneys. They produce two major hormones, *namely*, adrenin and cortin. Adrenin, as we have said, exerts a powerful influence upon bleeding, fatigue, the sugar level of the blood, and the contraction and expansion of the blood vessels and capillaries. We have previously discussed these influences. Over-production of cortin is assumed, among other effects, to influence the secondary sex characteristics. The husky, deep voice of a female may be a particular instance here; there is a tendency toward masculinity. Under-production is accompanied by a lower oxidation rate and a sluggish, indifferent activity level.

The endocrine glands unquestionably affect the bodily structures and physiological functions of the organism, either directly or indirectly. Moreover, any condition that contributes to a feeling of inferiority and personal depreciation works indirectly upon man's psychological activities. Important as each hormone may

be, it is extremely difficult (and in many cases impossible) to isolate the particular effects which it produces. The glandular mechanism is a strikingly coöperative unit. When one glandular product is subtracted, others immediately "step forward." There follows then a rearrangement (new balancing) of chemical determiners, thus marring the clarity of the causal picture. When too much of one hormone is added, the same chemical rebalancing commonly occurs. The evidence indicates, for instance, that following the removal of the thyroid, the productive level of the pituitary gland seems to be significantly raised. Yet it does not seemingly take over all duties of the thyroid. Evidence also indicates that a loss of the pituitary functions is directly followed by excessive thyroid activity. With this very delicate balancing properly understood, it is sheer speculation, for example, to refer Napoleon's pugnacity, animalism, and genius to the influence of his pituitary and the adrenal functions. Again, while we recognize that endocrine products definitely affect man's *bodily properties*, we cannot refer many cases of dwarfism and gigantism to particular glandular sources. Different writers have claimed that the former sort of individual is determined most often by the pituitary and the thyroid glands. Some have also suggested that the latter *may* be due to the gonads and the pituitary.

b. Psychoanalytical. Freud and his students have sought to relate personality to a sexual basis. For his earliest days, the developing individual is assumed to seek gratification of a sexual nature. Back of each important phase of life activity, therefore, stands this fundamental possibility of satisfaction. Out of this particular urge issue the various *conflicts* of life. The failure to achieve adequate gratification on this basis leads to the less serious troubles of normal and the more serious troubles of abnormal individuals. Where gratification is seemingly impossible, the individual may *repress* all meaningful references to some satisfying object; complete forgetting may thus occur. Or, instead there may merely be *dissociation*. This condition implies that gratification is to be found in particular situations which are cut off from the more common situations of life. In short, two socially or personally incompatible sources (ways) of securing satisfaction may simultaneously exist. The individual, however, prevents conflict and friction by keeping these two different forms of satisfying situations separated. The common psychological mechanism

whereby this separation is successfully sustained is *rationalization.* In this way, the individual finds plausible "reasons" to bolster the division. One may, for instance, contend that his health or his work or his efficiency definitely demands that he find adequate satisfaction in a particular way even though it should seemingly conflict with his personal and group standards. Rationalization is *in part* the formulation of an acceptable cause to explain an otherwise unacceptable mode of behavior. While it appears in the normal, it is most striking in the abnormal. Such an individual, as we said in Chapter III, may seriously contend that he is in an institution because some person hates or envies him or wishes to remove him in order to achieve a particular end — get his money, his wife, or his job. When one of the two distinct systems becomes partially repressed, that is, when it may occasionally appear and dominate the personality picture, we have a case of fluctuating (dual) personality.

The psychoanalyst also suggests that at times every normal individual shows *regressive* personality traits. That is, an adult individual when possibly denied gratification in one life situation may again produce those situations which were earlier satisfying. The individual is assumed to function at the simpler levels of his life where conditions are less exacting and satisfaction is more easily achieved. According to this interpretation, one form of such living appears in day-dreaming. It is accordingly maintained that phantasy or day-dreaming is really a pre-adult (infantile or adolescent) form of gratification. Its excessive use, therefore, constitutes one symptom of an individual's inability to live and find adequate gratification at a mature level. The abnormal individual is one who has come to depend too largely upon this form of gratification. He has escaped by way of phantasy. The difficulty of dealing therapeutically with such individuals is assumed to rest upon their unwillingness to discard such satisfying forms of life. In short, the psychoneurotic person has failed under normal life conditions to find adequate sources of gratification which are at the same time both personally and socially acceptable. Their cure accordingly demands the discovery of sources which are not forbidden. When such proper sources are found and the energy of the sex urge is expended upon them, the individual is able to continue his normal life. Such discovery and redirection of energy is said to constitute the process of *sublimation.* Sublimation is simply the expression

of the sexual urge in an approved manner. The individual who can sublimate most readily and effectively supposedly encounters the least difficulty in life. He avoids conflict and friction.

c. **Personal History and Environment.** The endocrine glands with their various chemical products are important factors in personality. They are hereditarily determined. The sex urge of the psychoanalyst is also a definite hereditary contribution which emerges at birth. Regardless of particular theory, the way in which an individual finds satisfaction necessarily depends upon the opportunities afforded by his environment. Freud, for instance, lays full emphasis upon the significance of an individual's personal history. He has given wide significance to the genetic approach. We have, therefore, the picture of a hereditary mechanism which strives always toward environmental gratification. The significance of such striving as a determiner of personality is widely recognized. But there are many situations in life in which sex does not enter. Other factors dominate. These are also significant for personality. The nature of an individual's standards, goals, aims, purposes, and sources of non-sexual satisfaction cannot be ignored without doing violence to our understanding. The wide influence of familial and non-familial associates must be sensibly considered. Data on delinquent boys and girls reveal that when their life situations are greatly changed by placing them under new social and economic conditions, as many as 75 per cent to 90 per cent conform desirably. Since personality is essentially a matter of social behavior, the particular group of which the individual is an integral part must be always considered in the total causal picture. Personality cannot be understood apart from a human environment. Man is a dynamic unit, endowed with inherent needs, which functions continuously. In so far as an individual's needs, products, activities, or behavior may be stamped with diverse situational meanings such as honesty, loyalty, honor, kindliness, and tolerance, we can sensibly refer to a human personality.

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